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ORIGINAL MEMOIRS.

THE USE OF ETHYL CHLORIDE AS A GENERAL ANÆSTHETIC IN THE PENNSYLVANIA HOSPITAL.*

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DR. CHARLES F. MITCHELL, in the winter of 1902, first used ethyl chloride for general anæsthesia in the receiving ward of the Pennsylvania Hospital, and it proved so satisfactory for short light anæsthesias that it was introduced into the general surgical wards and there used for minor operations and painful surgical dressings. Dr. Francis O. Allen, when Resident Anæsthetist, first used it in combination with ether and chloroform during the early part of 1903.

There are now records of its use in 5575 cases during the period commencing December, 1902, and ending June 1, 1908, as follows: Alone, in 947; with anesthol, in 47; with anesthol and ether, in 391; with ether, in 4148; with scopolamine and morphia, in 1; with chloroform, in 2; and with intraspinal injections of stovaine, in 39.

The youngest patient was 24 hours old and the oldest 84 years. The lengths of the anæsthesias have varied from several seconds to 54 minutes. The average dosage for 3 minutes has been 10 grammes.

* A preliminary report read before the Philadelphia Academy of Surgery, June, 1908.

Bengue's preparation of ethyl chloride was first used, but it was soon found that an American product known commercially as antidolorin was just as satisfactory and the latter has been used in practically all of the cases.

Several of the many forms of closed and semiclosed inhalers devised for its administration have been tried and abandoned for gauze. If a prolonged anaesthesia is desired or the ethyl chloride is to be followed by another anaesthetic, the patient should have the usual anaesthetic preparation; otherwise, it may be given without this preparation. Lying in the supine position the patient is told to breathe quietly, close the eyes and prepare for sleep. Upon several layers of wide mesh gauze, held from 6 to 8 inches from the face, the anaesthetic is slowly dropped. As the patient becomes drowsy the dose is increased and the gauze brought closer to the face and with the loss of consciousness, the gauze, 4 to 8 layers thick, is placed over the mouth and nose and the ethyl chloride given with the spray. Sometime before the loss of consciousness the patient is anaesthetic to very severe pain and many minor operations requiring but a few minutes may be done in this stage. Frequently in this stage there is a respiratory arrest, especially if the anaesthetic has been given too rapidly or too concentrated, but with its continued administration the respirations are resumed becoming slower and deeper. With the progress of the anaesthesia the eyeballs begin to roll and the pupils partially dilate when the patient enters the second stage, in which there is deep anaesthesia without, however, much muscular relaxation and with, frequently, considerable muscular rigidity and spasm. Progressing still further the eyeballs become fixed, the pupil widely dilated and immobile, the corneal reflex disappears and the face is flushed and covered with perspiration. This is undoubtedly the danger-line beyond which the respirations become insidiously shallower with consequent deepening cyanosis, there may be an external squint of the eyeballs and frequently muscular rigidity and spasm or as rarely occurs general relaxation. The fatalities seem to be due primarily to respiratory and secondarily to cardiac failure.

Large and Brown, in their experiments on dogs, seem to have confirmed the clinical observations that there is always a fall of blood-pressure, which in a few cases may be preceded by a temporary rise, and their explanation of the respiratory failure is that it is due to a paralysis of the respiratory centre produced possibly by the lowered blood-pressure.

When ether is to follow the ethyl chloride it is gradually introduced drop by drop upon the same gauze at the period when the patient loses consciousness and while its dosage is rapidly increased, the ethyl chloride is gradually withdrawn. If, however, a sudden change is made from the ethyl chloride to the ether, the patient will in the majority of cases recover from the ethyl chloride intoxication before that of the ether appears. It is the feeling in the hospital that with this slow induction requiring from 2 to 3 minutes, the gradually increasing dosage and the free admission of air allows a more careful observation of the progress of the anaesthesia and a timely recognition of the danger-line, and when one remembers that with large concentrated doses and a closed inhaler a patient can be carried beyond this line in from 8 to 20 seconds this will be understood, also with this method we do not have the frequent occurrence of muscular spasm, post-anaesthetic vomiting and headache so strongly emphasized by those using the closed method.

Safety is undoubtedly the first consideration in the use of any anaesthetic and though ethyl chloride has been used since 1847 and very generally used in England and on the continent since 1897 there is still a great difference of opinion as to its mortality. Hewitt places it between ether and chloroform with an estimated mortality of 1-10,000 and in the latest edition of his book quotes McCardie's figures of 1-3000. Luke makes one estimate of 1-8000 and a few months later 1-150,000. Each of these men have had personal experience in over 2000 cases without any fatalities. Herrenknecht reports 3000 cases without a mishap.

Such varied difference of opinion, Hawley suggests, would indicate that there may be other elements present, indepen-

dent of the anaesthetic itself, to cause death, and a careful analysis of the reported fatalities seems to support this suggestion. There are recorded in literature in a rather imperfect way some 21 cases which have been collected by Luke, and to these we now add 4 more. Another fatal case reported by Dr. Allen is case No. 3 in this list.

In view of Hawley's suggestion an analysis of these cases is very interesting.

Case 2 was a 12-months-old child with diphtheritic laryngeal obstruction.

Case 5 was a large healthy man 24 years of age with a huge submaxillary abscess. Several minutes after the removal of the anaesthetic and after the abscess had been opened, respirations stopped so suddenly as to suggest that there was some acute laryngeal obstruction. At least four minutes later a tracheotomy was done without the reestablishment of respiration. The autopsy showed marked oedema of the glottis with a relaxed fold of the mucous membrane over the abscess wall "which might have been" sucked into the small air-passage of the glottis.

Case 6, a male 67 years old, whose autopsy showed a very large mass of malignant cervical glands encroaching upon the lumen of the pharynx and larynx and involving the vocal cords.

Case 3, reported by Dr. Allen in 1903, was a colored man 28 years of age with an incarcerated hernia. He had been vomiting freely but the vomitus was not fecal in character, otherwise his condition was good. During the change from ethyl chloride to ether he suddenly recommenced vomiting and brought up large quantities of a clear fluid. This lasted three to four minutes, after which respirations were not resumed. An examination by the surgeon failed to show any pharyngeal or laryngeal obstruction and he considered it an anaesthetic death. There was no autopsy.

Case 22.—Ethyl chloride was chosen as the anaesthetic for a negro 17 years of age, with an acute ischio rectal abscess, because of a harassing cough, profuse expectoration and signs of a chronic consolidation of the left lung. He was placed in the lithotomy position, and though never deeply anaesthetized, received considerably more than the usual ten grammes for the anaesthesia

extended over a period of more than 15 minutes. Ten or fifteen minutes after the withdrawal of the anæsthetic there was a violent paroxysm of coughing, after which the respirations ceased and were not reestablished with vigorous stimulation, artificial respiration and tracheotomy. The pulse in this case continued beating for some time after the respiratory arrest. At the post-mortem examination the whole left lung was found to be involved in a tuberculous consolidation with a small cavity in the apex; there was a tuberculous pericarditis with a large amount of fluid in the sac and a tuberculous peritonitis.

Case 23.—A negro 30 years old, while attempting a highway robbery one week previous to his admission to the hospital, received a load of buckshot in the lower part of the left axilla. He had remained in hiding all this time without medical attention and when he entered the hospital there was a large gaping wound in the lower portion of the left axilla and the physical signs of a general peritonitis and profound sepsis. While being placed upon the operating table his pulse became imperceptible and after receiving less than a gramme of ethyl chloride given in the usual way and before any operative procedure could be commenced his respirations gradually ceased. The autopsy showed a large wound of the left pleura and an empyema of the same pleural cavity; a wound and empyema of the pericardial cavity; a wound of the diaphragm; perforations of the stomach and intestines and a purulent peritonitis.

Case 24.—D. H., an unmarried negress, 30 years of age, was being treated in the medical wards for *Adiposa Dolorosa* and developed a Ludwig's Angina, associated with marked laryngeal obstruction. Incisions beneath the jaw opened the sublingual tissues and allowed a few drops of pus to escape. When the patient was placed in the dorsal position the laryngeal obstruction was considerably increased and after receiving about 5 grammes of ethyl chloride given in the usual way her respirations stopped, the pulse remaining unaffected, but with the removal of the anæsthetic and artificial respiration they were quickly resumed. Twenty-four hours later, the œdema and the laryngeal obstruction having increased, another operation was attempted and as before the respiratory obstruction was greatly increased by the dorsal position and after receiving about a gramme of ethyl chloride it became complete and was never reestablished,

though a quick tracheotomy was done. The autopsy showed acute inflammation and oedema of the pharyngeal, sublingual and cervical tissues with oedema of the glottis.

Case 25.—A young married negress with the diagnosis of tubo-ovarian abscess was given an unknown quantity of ethyl chloride preliminary to a proposed ether anaesthesia. After taking the anaesthetic for one or two minutes the respirations suddenly ceased and though the pulse could be felt for a short time after the respirations had stopped it soon disappeared and cardiac stimulants together with artificial respirations produced no effect. There was no postmortem examination and a physical examination made just before the anaesthetic was given was negative except for the presence of a loud systolic heart murmur without any signs of lost compensation.

Seven of these fatalities recorded in the literature occurred during dental operations and the anaesthetic was given by the dentist or his assistant. In eight cases the patients were in the upright position when the ethyl chloride was administered. In seven cases where the method is recorded a closed or semi-closed inhaler was used 3-6 c.c. of the ethyl chloride being sprayed at once into the bag and given to the patient.

The occurrence of several deaths under anaesthesia at Guy's Hospital is the cause for an editorial in the *Hospital*, London, in which anaesthetic deaths are carefully considered. During the period of 6 years from 1901 to 1907 there occurred at Guy's 36 deaths under anaesthesia; in another hospital 31 in 85,000 anaesthesias, and in still another 7 in three years. And it raises the question of whether it is right to credit all of the operative deaths which occur under anaesthesia to the anaesthetic when the surgeon wishing to give the patients every possible chance will operate upon them when almost moribund. It also criticizes the compiling of statistics from various hospitals and thus estimating mortalities.

With these criticisms in mind we have reviewed the records of all the anaesthesias given in the hospital during this same period of five and a half years. They were administered by

the Resident Anæsthetizers and Resident Physicians. Squibb's ether was used in practically all of these cases. In a very few, during the early part of the period, the anæsthetics were given with an Allis inhaler, in all of the remaining ones the gauze and drop method was employed.

There have been 5575 cases in which ethyl chloride has been used as a general anæsthetic and during the administration of which 5 cases died. The ethyl chloride was used alone in 947 times and all of these deaths occurred while it was being used in this way and none when used in combination with other anæsthetics, ether, chloroform, or anesthol, of which there were 4628. The fact that the ethyl chloride was given first and to all the cases which were considered bad anæsthetic risks distorts these statistics:

Ether was given 5592 times and during its administration 3 deaths occurred. As with the ethyl chloride all of these deaths occurred while it was being used alone in 1444 cases, one as the operation was begun, the other two near their completion.

An agent which may in 15-20 seconds produce deep anæsthesia and whose danger-signs are so easily passed cannot be used with impunity, and a few of the reported fatalities certainly demonstrate its danger in inexperienced hands. Another objection to its use is the muscular spasm and rigidity which occurs especially in alcoholics and very frequently in others. This, however, may be overcome more or less by the preliminary use of morphia and atropine and by following the ethyl chloride with ether.

Its advantages, on the other hand, are very tempting. For the patient there is no irritation of the respiratory tract with its usual coughing, increased secretions, gagging and vomiting; and therefore no respiratory struggle so often seen in ether and chloroform anæsthesia. The rapid onset of unconsciousness is not to be overlooked and its advantage will be appreciated by any who have taken ether patiently for 6 to 10 minutes. And most important the usual amount of ether necessary for the induction of anæsthesia to the third stage is

eliminated and as this averages four ounces with the open drop method the excretory organs are saved a considerable task. In our experience it certainly lessens the occurrence of post-operative vomiting.

To the anæsthetist the ease and rapidity of induction with complete elimination of the preliminary stages of ether and chloroform speaks for itself.

Though the mortality with ethyl chloride in this series of cases, is apparently greater than that of ether it is still being used in the hospital for (a) minor surgical procedures where a short anæsthesia of a few seconds to five minutes is desired; (b) the dressing of the more painful surgical wounds, such as the removal of abdominal packs; (c) and in combination with ether and chloroform.

LUDWIG'S ANGINA.

REPORT OF FIVE CASES INCLUDING ONE AUTOPSY.*

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IN the year of 1836, Dr. Ludwig of Stuttgart, described an acute septic inflammation of the submaxillary region, accompanied by a hard sublingual swelling, together with the symptomatology. This condition has been designated Ludwig's angina. Dr. Thomas has recently collected 106 cases in the literature including two of his own with a mortality of 40.3 per cent. I take this opportunity to express my indebtedness to this comprehensive article by Dr. Thomas for many of the references in my own paper. Probably many cases have occurred which have not been recorded. That it sometimes occurs in groups has been observed by F. Murchison, Klein, Seymour-Taylor and G. G. Davis. The latter says that five of his cases came from the same section of the city in a period of five weeks.

The five cases which I am reporting were admitted to the Episcopal Hospital, Philadelphia, between March 1 and May 12 of this year. Although two of them developed in the same ward of the hospital, I do not regard the condition contagious.

1. *The Infecting Organism.*—No specific organism has been found for Ludwig's angina. Dr. Thomas searched the literature and found eighteen cases reporting the bacteriological findings as follows:

The streptoccus was found alone in six cases. The streptococcus associated with other organisms, staphylococcus and diplococci in eight; the staphylococcus alone in two; the pneumococcus alone in one and an undetermined bacillus in one.

* Read before the Philadelphia Academy of Surgery, June 1, 1908.

In my cases the following organisms were found:

CASE I.—Cultures and smears show mixed bacteria flora.

CASE II.—Cultures and smears show mixed bacteria flora—Staphylococcus, micrococcus salivarius—Biondi; Streptococcus cappelletti.

CASE III.—Micrococcus salivarius—Biondi.

CASE IV.—Micrococcus salivarius—Biondi.

CASE V.—Cultures from incision show Bact. ferrugineum. (Dyal); by aspiration, large diplococcus, small diplococcus, long, thin bacillus, streptobacillus (strepto-diplo-bacillus?).

2. *The Primary Focus of Infection.*—The most common primary focus of infection is dental caries. Dr. Davis reported one case in which the inflammation was started by a dentist injecting a solution of cocaine around a carious tooth and extracting it. Two of the cases now reported started in this manner. After cocaine had been injected in the gums and the tooth extracted, Case IV developed a submaxillary swelling in 48 hours and Case V developed a submaxillary swelling in 24 hours. Case III had carious teeth and a submaxillary swelling of a month's standing but a sudden enlargement of this swelling developed in four to eight hours after a dentist had pulled a tooth. Other foci that have been mentioned are wounds of the mucous membrane, otitis media, peritonsillar abscess. C. J. Aldrich reports a case that started from the tonsil and W. A. Humphrey describes a case preceded by tonsillitis.

One of the present patients (Case I) had an attack of tonsillitis with a temperature 103 which gradually subsided to normal in five days, but six days later the patient developed Ludwig's angina. Case II complained of sore throat and examination showed redness of the pharynx; the next day the patient had developed Ludwig's angina and in 55 hours he was dead.

3. *The Mode of Transmission of the Infection.*—If the primary focus is in the tooth as in Case III, IV and V, I agree with Dr. Davis that the inflammation involves the periosteum of the lower jaw and thence invades all the surrounding tissues

by direct contiguity. But if the primary focus is the pharynx (Case II) or the tonsil (Case I) or some other point distant from the submaxillary region, it is probable that the infection was carried by the lymphatics. It is possible there is transmission of the infection from the mouth by the ducts of the sublingual gland which show marked inflammatory cellulitis in the sections from Case II.

Regardless of the seat of the primary focus, the secondary infection in these cases is in the submaxillary region; the floor of the mouth; and the following muscles: digastric, stylohyoid, mylohyoid, geniohyoid, geniohyoglossus, hyoglossus, chondroglossus, styloglossus, palatoglossus, sternohyoid, sternothyroid, thyrohyoid, omohyoid.

The connecting tissues and overlying subcutaneous tissue are also affected. The pharynx and larynx become rapidly involved. In a fatal case, as in Case II, the entire trachea may be invaded. The cellular infiltration travels by the lymphatic spaces and by contiguity.

The clinical picture of the condition given by Ludwig was that of a fatal case.

The following are the symptoms of the early and less severe types:

Constitutional.—There is early fever, temperature 99 to 103, headache, malaise, loss of appetite and insomnia.

Local.—Increase in the secretion of saliva which is of a thickropy character. If there is an opening into the mouth there is a profuse mucopurulent discharge together with the saliva which may amount to as much as sixteen ounces in twenty-four hours. Soon the patient notices a submaxillary swelling of a shoe-leather resistance which is painful. There is also tenderness which may be marked or slight. Then there is rapid oedema of the sublingual tissues and swelling of the face as far up as the malar bone and swelling of the neck down to the clavicle. The larynx and pharynx are rapidly affected and there is difficulty in opening the mouth, in swallowing, talking and breathing.

Treatment.—As soon as the diagnosis is made, use local

anæsthesia (ethyl chloride) and make incisions over the submaxillary triangles through the mylohyoid muscles and if there is severe swelling also through the median line between the hyoid bone and the symphysis to the mucous membrane. Use rubber drainage-tubes through and through the lateral incisions.

If the sublingual tissue is markedly œdematosus, incise the mucous membrane from the midline to the second molar tooth and then insert a curette and curette wherever there is a feeling of the tissues giving way. There is usually a profuse discharge of blood which clots immediately. There will then be a profuse mucopurulent discharge of a very foul odor and bad taste. The relief is instant. You can actually see the sublingual œdema subside, and the patient will tell you that he can talk better and you will be able to notice the change in the voice.

Prognosis.—Dr. G. G. Davis reports mortality 40 per cent. in the cases under his own care. Thomas in his recent paper gives the mortality as 40.3 per cent. for all the cases reported.

Of the five cases now reported, one died and four recovered—mortality 20 per cent. The first of these patients was admitted to the Episcopal Hospital in the service of Dr. William T. Van Pelt and the other four in the service of Dr. Thomas R. Neilson with whose kind permission they are presented.

CASE I.—(Surgeon, Dr. William T. Van Pelt). J. T., age 29 years. Admitted December 24, 1907; suffering from interstitial keratitis. February 13, 1908, complained of sore throat, headache, backache and loss of appetite. 5.30 P.M. Examination: throat, pharynx and tonsils are red. 11.50 P.M., tonsils are slightly swollen and show a few follicles filled with pus. Treatment: H_2O_2 and $AgNO_3$ gr. 1x to $\frac{1}{2}$ i.

2-20-'08. Less pain in the throat. Tonsils are swollen and some crypts contain pus. Anterior cervical glands are enlarged.

2-23-'08. Very few crypts contain pus. Has no pain. Feels well. Temperature 98°.

2-29-'08, 9 A.M. Has complained all night of not sleeping and of pain in the throat. Difficulty in swallowing. Examinations show tonsils red and anterior cervical glands are enlarged and painful.

3-1-'08, 12.15 A.M. Complains of pain and swelling of floor of mouth and difficulty in talking and drinking. Cannot take food. Examination shows marked cellulitis of neck and the submaxillary region is very painful and tender to touch. Very hard. Difficulty in moving tongue and opening mouth. Marked œdema of floor of mouth and mucous membrane. Tongue is swollen. Increased saliva. Condition resembles Ludwig's angina.

Operation by Dr. Price:—Local anaesthesia—ethyl chloride. Three incisions are made. One in the median line below the chin and two lateral incisions into the submaxillary triangle. Blood and serum flowed freely. Subcutaneous tissue œdematous. A rubber drainage-tube is passed through and through the lateral incisions. Patient says he feels much better.

3-1-'08. P.M. Patient is doing nicely. Not so much submaxillary swelling.

3-2-'08 (1st day after operation). Dr. Davis examined patient and considered it Ludwig's angina. Dr. Davis passed a knife by median incision, through the floor of the mouth. Incisions are draining blood and serum. Patient feels better. He can get his mouth open more easily. Tongue is only slightly swollen.

3-3-'08 (2nd day). General condition is very much better. Not so much swelling. Patient is expectorating a foul, bloody mucopurulent sputum. The pharynx is not so congested. Incisions are draining bloody serum—no pus. *Tube removed.* Iodoform gauze inserted.

3-4-'08 (3rd day). Says he feels quite well. Tongue is normal. The lymphatics are markedly improved; only slightly enlarged. Feels like eating. Incisions are draining very little.

3-5-'08 (4th day). Doing splendidly. All symptoms have subsided. Temperature normal, 98.2° . The cornea is also much clearer than it has been.

3-15-'08. The incisions are granulating. Cultures and smears showed mixed bacteria flora.

4-8-'08. Discharged. The cornea is still cloudy and conjunctiva is slightly congested. Has no pain. Vision is fair.

CASE II.—(Surgeon, Dr. Neilson). W. T., age 80 years. Diagnosis: On admission, leg ulcer. Revised, complications, œdema of larynx, nephritis, myocarditis, arteriosclerosis, submaxillary adenitis, Ludwig's angina. Result: Died.

December 30, 1907. Patient was admitted to hospital for leg ulcer, size of silver dollar.

April 4, 1908. Complained of sore throat. Examinations showed redness of pharynx, especially on left side. Teeth are mostly missing, but there are several stumps or snags in bad condition.

On the next day there was difficulty in speaking. Examination showed œdema of sublingual tissue and slight cellulitis of submental region and submaxillary regions, especially the left.

Operation by Dr. Price: Multiple incisions made in mucous membrane beneath the sides of the tongue. Local condition not relieved.

By the following day, 8 P.M., sublingual œdema increased and patient does not talk so well. Has difficulty in breathing and swallowing and does not take food. An incision is made in the mucous membrane for one inch parallel to the alveolar margin along the base of the tongue on both sides. An incision is made in the median line into the sublingual tissue. These incisions seemed to relieve the patient at once of some of the œdema. He said he felt better and could talk more distinctly.

4-7-'08 (2nd day). Patient died at 6.45 A.M. It is said by the nurse that just before death he was talking to a patient in the next bed and that suddenly he fell over dead.

AUTOPSY.

Tongue.—Tissues of the mouth beneath the tongue seem to be swollen and œdematous; posterior part of the tongue is slightly swollen. Both tonsils are greatly enlarged, swollen, and on section in places show oozing of a small amount of thick creamy pus.

Pharynx.—Epiglottis greatly swollen and congested, reaching in places nearly half an inch in thickness. The larynx in the region of the vocal cords is greatly swollen and congested and œdematous, showing acute inflammatory œdema. The left side of the epiglottis and the larynx seem swollen more than the right.

Cultures were made from the larynx, from the tissues in the immediate vicinity of the larynx, and from the base of the tongue.

Smears from these regions were also made. The streptococcus capelletti and the *micrococcus salivarius*—*Biondi* were found.

Trachea.—Showed marked swelling of the mucous membrane covered with a fibrinous mucopurulent exudate throughout.

MICROSCOPICAL SECTIONS

1. *Tonsil*.—Shows marked congestion, vessels are markedly dilated and filled with blood; the crypts are filled with plugs of granular debris containing bacteria. The peritonsillar tissue shows marked congestion and marked oedema and the perivascular spaces show large collections of leucocytes.

2. *Epiglottis*.—Section shows epithelial surfaces everywhere covered with much mucus, epithelial cells and leucocytes. Below epithelium the tissue is everywhere infiltrated with leucocytes, red corpuscles and inflammatory oedema. In some areas these collections of leucocytes, especially around the vessels, form distinct round abscesses. The vessels are everywhere markedly congested. This inflammatory oedema and exudation extends down to the cartilage.

Base of Tongue and Sublingual Gland.—The sublingual gland shows marked inflammatory cellulitis. The stroma is markedly infiltrated with leucocytes. These cellular infiltrations are so great that they press on the glandular tissue in many places to such an extent that the normal shape is lost. The tissues surrounding the gland contain considerable fat markedly infiltrated with large areas of leucocytic collections. These collections of leucocytes are so great that they form small pockets of pus.

The inflammatory infiltrations *i. e.*, the leucocytic collections continue to the underlying muscular tissue and infiltrate the muscle fibres, separating them from one another. The intermuscular tissue in this area also shows considerable oedema and in some places there are to be seen small hemorrhages. All of the blood-vessels are congested.

Base of Tongue and Submaxillary Gland.—The submaxillary gland is apparently normal. The borders show slight inflammatory oedema and collections of leucocytes. The remainder of the section shows a similar condition described in section 3, *i. e.*, inflammatory exudate, oedema, hemorrhages and pus. Sections 5 and 6 also taken from the base of the tongue at different points show the same conditions. These six sections have also been stained to show the presence of bacteria. In the infiltrated areas there are moderately large micrococcus; a small diplococcus; a small diplococcus in chains. The study of sections with the microscope seems to show that the cellular infiltration has travelled by the lymphatic spaces and by contiguity.

Diagnosis.—Acute oedema of larynx secondary to a phlegmonous condition of the soft parts surrounding; marked interstitial nephritis; marked myocarditis with calcification of the larger vessels and sclerosis of the mitral and aortic valves and coronary vessels; old tuberculosis of the apices of both lungs; atrophy of liver with fatty change.

CASE III.—(Surgeon, Dr. Neilson). T. C., age 29 years. Diagnosis: On admission, submaxillary adenitis and sublingual cellulitis. Revised, Ludwig's angina. Result: Recovered.

Was admitted to hospital April 21, 1908.

Present Illness.—Began one month ago with a swelling beneath the right inferior maxilla. This was painless and hard and of very moderate size. For past three weeks he has had neuralgia of left upper part of face. One week ago he had the left canine tooth pulled. This relieved his neuralgia. A few hours later the submaxillary swelling had increased. Upon the following day he noticed sublingual edema of right side only and swelling of right side of his tongue. This swelling rapidly increased so that on the morning of April 17, 1908, the tongue filled the posterior part of his mouth, touching the palate. On the left side of the tongue there was a small air-passage. He could breathe freely by the nose. Pain was due to pressure of tongue on the teeth. Speech was interfered with on account of inability to move his tongue freely. Says he was not hoarse. His breath was very foul. Saliva was increased to an enormous degree and was sticky and thick. Appetite was poor. He was able to swallow "milk and raw eggs," says that he would get this mixture in the anterior part of his mouth and then close the mouth and push the tongue forward like a wedge and thus force the mixture into the throat and swallow it. Temperature was not taken before 4-18-'08, and he does not know the degree. He slept in a sitting posture and the saliva would run from his mouth. His attending physician cut into the sublingual tissue but found only blood.

When admitted to hospital, April 21, his temperature was 100°; pulse, 72; respiration, 24. Fairly well nourished man who appears to be under tone. Face is drawn and cheeks are hollow. Pupils react. Tongue is coated gray throughout. It is swollen, especially on the right side, and posteriorly it touched the roof of the mouth. Speech is thick. Sublingual tissues are moderately edematous on the right side only from the midline posteriorly and are higher than the cutting edges of the teeth. A small gray membrane to the right of the midline of the sublingual tissues marks the point of the attending physician's incision. Right first molar is carious and other teeth contain cavities. In the right submaxillary region there is a hard swelling slightly

nodular extending from the midline to the angle of the jaw. This swelling is not very prominent. Heart and lungs are normal.

11.30 A.M. He says that he expectorated three large masses of yellow-greenish mucopurulent material of very bad odor and taste one after another. These seemed to come from behind his tongue. He began to rapidly improve. Swelling of tongue decreased and he is able to speak more clearly.

3.30 P.M. Examination shows no discharging point, although the sputum cup is full of mucopurulent material and thin watery matter. This has a bad rotten taste.

5.30 P.M. Operation by Dr. Price: sublingual tissue is still cedematous and an incision is made into it, starting at the midline and going back to the last molar tooth. A curette is inserted (1½ in.) and used thoroughly. A great deal of blood that clots instantly is removed, also small bits of caseous material—possibly glandular. A small amount of light greenish mucopurulent material is seen. This seemed to come from near the midline. The curretting caused little pain. Pressure on the outside did not increase the flow. Cultures from incision showed "*micrococcus salivarius*—Biondi." *

During the day thereafter, sublingual œdema and swelling of tongue became very much less. General condition very satisfactory.

By the third day the tongue was normal. Sublingual œdema slight.

Steady improvement thereafter; patient was discharged on the ninth day.

CASE IV.—(Surgeon, Dr. Neilson). J. D., age 22. April 24, 1908, a dentist injected cocaine around the first right molar in the lower jaw and extracted the tooth. Two days later he noticed a very hard painful swelling below the right inferior maxilla; began to lose his appetite, had slight headache and malaise, causing him to stop work after five days. May 1, he had difficulty in talking and swallowing, his voice was husky.

* *M. salivarius*—Biondi.—Morphology, cocci round slightly oval, stain by Gram's method; gelatin colonies, surface: round, grayish-white, which may become darker; gelatin stab, in depth beaded, white; potato: growth scanty; pathogenesis, innoculations of mice, guinea pigs and rabbits cause death in four to six days, cocci in organs, no inflammatory reaction in tissues; habitat, saliva of man.

After another day he had difficulty in breathing. May 3, he came to the hospital surgical dispensary when sublingual oedema was observed by Dr. Ivy. Then patient refused to remain in the hospital. The swelling continued to increase in size until 8 P.M. He had dull pain through his neck and cough and increased saliva. By the next day he had such difficulty in opening his mouth that he said he thought he was getting lockjaw and came to the hospital. He has been unable to sleep. He was finally received at the hospital May 4, 1908. He walked to the hospital. When admitted his temperature was 99.2°. Pulse, 92. Respiration, 26. Blood: leucocytosis, 12,200. The right cheek is swollen. There is a hard firm swelling the size of a half egg in the right submaxillary region. The submental region is also swollen from the symphysis to the hyoid bone and extends two fingers to the left of the median line. The sublingual tissue on the right side is markedly oedematous, being above the cutting edges of the teeth and pushes the tongue upward. On the left side it is only slightly oedematous. The tongue is covered with a gray pia. It is not swollen but it cannot be protruded beyond the lips. The face is flushed and the pupils dilated. Chest: lungs; left-apex resonance is impaired. The breath sounds are harsh. Remainder of lungs are clear. Heart: muscular tone is good. No murmurs. Abdomen is normal.

2.45 P.M. Operation by Dr. Price: One incision is made in the median line from without inward through the floor of the mouth. A second incision is made over the right submaxillary triangle through the mylohyoid muscle. A haemostat is passed in beneath the mylohyoid from the lateral incision to the median incision and a rubber drainage-tube is inserted through and through. A third incision is made in the right sublingual tissue and a curette inserted. Nothing but blood and bloody serum removed. The blood clots instantly. No pus found. Wet dressing applied. Alcohol 65 per cent. Bichloride of mercury 1-4000 ää. Patient says that he feels much relief. Says that he can talk better.

7 P.M. Patient is expectorating large amounts of saliva and blood and blood-clots.

5-5-'08. Had only few short naps during the night.

(1st day.) Says he feels much better than before the incisions were made. Has less difficulty in swallowing and talking.

FIG. 1.



CASE IV.—J. D. Showing the swelling in the submaxillary and submental regions, also the incision and drainage tube into the submaxillary triangle.

FIG. 2.



CASE IV.—J. D. Showing the drainage tube passing from the incision in the submaxillary triangle to the median incision in the submental region.

FIG. 3.



CASE IV.—J. D. Showing swellings of the right cheek, submaxillary and submental regions



His voice is still husky. He still has pain on swallowing. No headache. No appetite. No shortness of breath. This A.M. his expectoration consists of a thick ropy mucopurulent material. Redressed. Discharge is bloody. Small amount of pus about the ends of the rubber tube. The sublingual and submaxillary swellings are about the same as yesterday.

(2nd day.) Examination shows increased sublingual swelling on the left side. Sublingual tissues extend above the level of the edges of the teeth. The submaxillary swelling on the left side has increased and is very hard. The left cheek is swollen. (Right side.) The submaxillary and sublingual swellings have markedly decreased and the submaxillary region is not so hard. Right cheek is still slightly swollen.

Second operation by Dr. Price: An incision one inch long, parallel to the inferior maxilla over the left submaxillary triangle, is made through the skin and mylohyoid muscle. A haemostat is inserted and opened in all directions. To the left of the median line, one-half dram of pus is found. One or two large gas-bubbles are seen to come out with the pus. Cultures are made. The median incision is enlarged and a rubber drainage-tube is inserted through and through from the median line to the left lateral incision beneath the mylohyoid muscle. Original tube is removed and a fresh one is inserted in the region of the lateral incision. Wet dressings: Alcohol 65 per cent. Bichloride mercury, 1-4000 $\ddot{\text{a}}$ applied. (5 P.M.) Blood: Leucocytosis, 13,800. (6 P.M.) General condition is much better.

(3rd day.) Feels stronger. Sputum is foul and bad-tasting. He expectorates about two cupfuls each day, and each night. Examination shows all swellings much less than this A.M. Sublingual tissues especially appear almost normal. Swelling of right cheek has disappeared and swelling of left cheek is slight.

(4th day, 5-8-'08.) Blood leucocytosis, 8160. Slept almost the entire night. Expectoration for the night is one cupful. Appetite is better. Temperature, 98°.

Examination.—Swelling of left cheek has disappeared. Submaxillary and submental swellings are slight. Sublingual tissue appears about normal. Discharge is less and very foul. Steady improvement from this date and he was discharged from hospital well on tenth day.

Cultures from incisions showed *micrococcus salivarius*—*Biondi*.

CASE V.—(Surgeon, Dr. Neilson.) C. B., female, age 16 years. May 1, 1908, patient had the first right molar extracted. May 8 she had cocaine injected around the second right molar and the tooth was extracted. On the following day she noticed a submaxillary swelling that was very hard and painful. Two days later she noticed sublingual œdema, also a hard swelling in the submental region. She complained of difficulty in swallowing and was able to sleep only three hours during the night. The sublingual œdema increased and the swelling below the jaw became larger and more painful and tender. Also difficulty in swallowing. Difficulty in talking. Her voice is husky. Difficulty in opening her mouth. Loss of appetite, headache and malaise. Breathing is not affected. Increased saliva that is thick and ropy. Applied for admission to hospital on the twelfth of May.

Physical Examination.—Well-nourished girl. Mouth: numerous carious teeth. The first and second molars are missing on the right side. The gums at this point is covered with a thin grayish-yellow slough. The sublingual tissues on the right side are œdematous but do not quite reach a level with the cutting edges of the teeth; on the left side they are slightly œdematous. There is a swelling of the right side of the face and neck extending from the malar bone to the sternum. The swelling over the submaxillary triangle and the submental region as far as the hyoid bone is very hard and of a shoe-leather resistance. There is no fluctuation. The anterior cervical lymphatics are palpable as a small chain of beads on the right side only. The thyroid gland seems slightly enlarged. W. B. C., 20,440.

Operation by Dr. Price immediately after admission. Local anaesthesia with ethyl chloride. Two incisions are made. One over each submaxillary triangle, parallel with the jaw and about one inch long. The incisions passed through the mylohyoid muscle. There was a free flow of blood and serum. Nothing that could be considered pus was seen. The subcutaneous tissues were quite œdematous. A haemostat was inserted and opened in all directions and passed beneath the mylohyoid muscle from one incision to the other. A rubber drainage-tube was inserted through and through. Immediately relief followed the operation.

FIG 1.



CASE I.—Adeno-fibroma of the breast in a girl of 10 years.

FIG. 2.



CASE II.—Diffuse fibroma of the breast in a girl of 11 years. The general enlargement of the gland, tense and shining integument, and dilated subcutaneous veins simulated a sarcoma.

The following day the submaxillary and sublingual swellings were decreased. In the submental region the tissues were still quite hard. The swelling from the hyoid bone to the sternum had entirely disappeared. Patient much more comfortable. She expectorates a thickropy white sputum profusely. Breath is foul.

Gradual subsidence of all symptoms, resulting in full recovery and discharged well on the eleventh day.

Cultures from incision showed *Bact. ferrugineum* (Dyal) and from aspirated material showed: large diplococcus, small diplococcus, long, thin bacillus, shorter, thicker bacillus, *streptobacillus* (*strepto-diplo-bacillus*?).

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TUMORS OF THE BREAST IN CHILDHOOD.

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THE recent occurrence of two cases of tumor of the female breast in children in our own practice has induced us to make some further study on the general subject of tumors of the breast in childhood. A search of the literature has shown an apparent absence of systematic papers on the subject and we have thought it worth while to collect and analyze the scattered cases of these unusual affections. To the paper of Malapert and Morichau-Beauchant² we are indebted for the cases of angioma of the breast included in our own series. The remaining cases have been collected from the literature at large, mainly from case-reports in the journals. In addition to the complete histories of our own cases, we have made brief abstracts of all the other cases which we could find and analyzed them with reference to the pathology, symptomatology and treatment.

A large majority of tumors of the breast in childhood are benign in character. They may be conveniently divided into benign tumors of vascular origin and benign tumors other than those of vascular origin.

Vascular tumors of the breast exist as cutaneous, subcutaneous or intraglandular formations. This subject has been thoroughly investigated by Malapert and Morichau-Beauchant² from whose article on the subject most of the data here collected has been obtained. They have collected and analyzed all the recorded cases of angioma of the breast; among these were six, including one of their own, in children under sixteen years

of age. The first class are unimportant, have the characteristics of naevi occurring elsewhere, and are apt to be seen on or near the nipple. Bryant³ reports a case the size of a shilling, which was destroyed by the galvanic cautery.

In the subcutaneous variety the cellular tissues are invaded by small tumors which may cause atrophy of the glandular structures by pressure. They are small, nodular, circumscribed and the overlying skin is healthy. The intramammary forms of glandular tumors are true angioma of the breast although it is difficult in certain cases to recognize the precise origin of the tumor. If situated near the nipple the glandular tissues may undergo atrophy but the ducts persist because of their greater resisting power. The affection may be diffuse as in Bajardi's¹ case, or less often, encapsulated. Both sexes are affected with equal frequency, the growths occurring either at birth or in the earliest months of life, and they may exist for years if not treated. The symptoms vary; at times an erectile tumor may be present, which is painless, the skin normal except for the presence of a few enlarged veins. In other cases, cysts may exist due to the presence of degeneration in the tumor. In outline the tumors are usually smooth, sometimes nodular, may fluctuate if cystic, are of slow growth and may bleed if ulceration of the skin occurs. There is a decided tendency toward involvement of the right breast as shown in six of the eight cases reported; in one instance only (Bittner) was a bilateral tumor present.

The treatment of vascular tumors of the breast depends upon their seat and size. Small superficial tumors require no treatment, or may be destroyed by the cautery, as was done in Bryant's case. The larger tumors, situated in the breast proper, require extirpation and in some instances are of such size, that complete removal of the breast may be necessary.

The reported cases of this type are as follows:

1. MALAPERT.²—Girl aged 12, developed an enlargement of right breast fifteen days after birth; and at the age of six months a decided enlargement was present. There was no pulsation in the tumor, which did not enlarge on straining and was painless. On palpation a smooth, fluctuating tumor, the size of an orange, was apparent, the skin free,

the mass movable on the underlying structures. Operation: Removal of three cysts and a solid mass, the microscopic examination showing an angioma with some breast-tissue remaining.

2. BAJARDI.¹—Child 2 years of age, tumor of right breast noted six months after birth, later attaining size of an orange. Skin blue around nipple. The tumor was slightly adherent to nipple which was slightly retracted, and on palpation was soft and elastic. It was reducible and was made tense on straining. Operation: Excision of tumor and nipple. Microscopic examination: Angioma with atrophy of breast-tissue.

3. COLZI.²—Boy aged 10 had enlarged right breast since early infancy. The tumor grew slowly until the whole gland and nipple were involved. The microscopic examination of the tissues removed showed an angioma and pressure atrophy of the breast.

4. ALTHORP.³—Boy aged 7, tumor in right breast since birth, very slow in development until the subject of trauma when it increased rapidly. The skin became discolored; the superficial vessels enlarged. The tumor was lobulated, movable, and fluctuating. Operation: Excision of cystic tumor containing 30 oz. fluid. Microscopically the mass consisted of angiomatous and muscular tissues.

5. WILLIAMS.⁴—Boy aged 7, developed a tumor in right breast, outside and below nipple, which was not involved. The growth was of five months' duration, about the size of a half crown, and firmly adherent to the breast. Diagnosis: Degenerated angioma. Operation: Removal of breast.

6. BRYANT.⁵—Girl aged 15 weeks; tumor involved whole breast and skin, nipple retracted. The tumor measured two inches in diameter, was spongy and prominent, covered by large veins. The whole swelling could be reduced by pressure. No treatment was instituted.

BENIGN TUMORS OTHER THAN THOSE OF VASCULAR ORIGIN.

As in the adult breast we encounter a variety of benign tumors of this type in the mammary gland in children. In describing these types they may be grouped clinically as benign, as the symptoms they produce are fairly constant. In most of the cases the tumors consist of a hypertrophy of both fibrous and epithelial elements, giving the usual appearance of fibro-epithelial growths as seen in the adult, and can be classified, therefore, as fibro-adenomata. A few instances of cystic disease of the breast and of lipoma in children are on record.

The two cases which follow were observed by us and are reported for the first time:

I. F. W., female, aged 10 years, was first seen in January, 1907, in the Surgical Dispensary of the University Hospital. The

child was poorly nourished and slightly anæmic. She complained of pain and tenderness in the left breast, particularly in the region of the nipple. There had been no traumatism suggestive of a cause of the pain. On examination the breasts were found to be in an undeveloped state, although the left one was slightly larger. Palpation caused some pain, and revealed a slight thickening of the tissue beneath the skin; local measures were instituted and the mother advised to have the child return if she noticed any subsequent enlargement of the breast. The condition remained unchanged for ten months when there was a decided increase in the size of the breast, which became more painful especially if handled. When examined one year after the first visit and two months after this decided enlargement, a small mass the size of an almond could be readily palpated. It presented the usual symptoms of a small adenofibromatous growth, being freely movable, and the overlying skin not affected. Enlarged axillary nodes or dilated veins were not present. Because the tumor was in intimate relationship with the nipple, the possible danger of atrophy of the breast following removal of the growth was considered and explained, and operation advised in view of the possible malignancy due to the sudden increase in size. The operation was performed by Dr. John Speese. The rudimentary gland was exposed by an incision $1\frac{1}{2}$ inches in length at its base; and the tumor removed. It was encapsulated, slightly adherent to the portion of the gland beneath the nipple, so that in its removal it was impossible to avoid some injury to the ducts; it was easily stripped from the pectoral fascia. The incision was closed by a few interrupted sutures and the wound healed rapidly with practically no scar. *Microscopically*, the tumor consisted of a fibroepithelial formation showing a typical adenofibromatous growth (see Fig. 1). The glandular part consisted of a few acini, the greater portion being derived from the ducts, which were lined with cuboidal epithelium.

II. Addie P., colored, aged 11. Admitted to the Children's Hospital, April 23, 1907. Service of Dr. J. H. Jopson. An only child. Both parents living and well. No history of specific or malignant disease. No illness except measles and pertussis. Has never menstruated. Enlargement of right breast, stated to have been noted first by the child some eight weeks before. Mother

has observed it for four weeks, during which time it has rapidly increased in size. Occasional sharp pains in breast for several weeks. No other symptoms complained of.

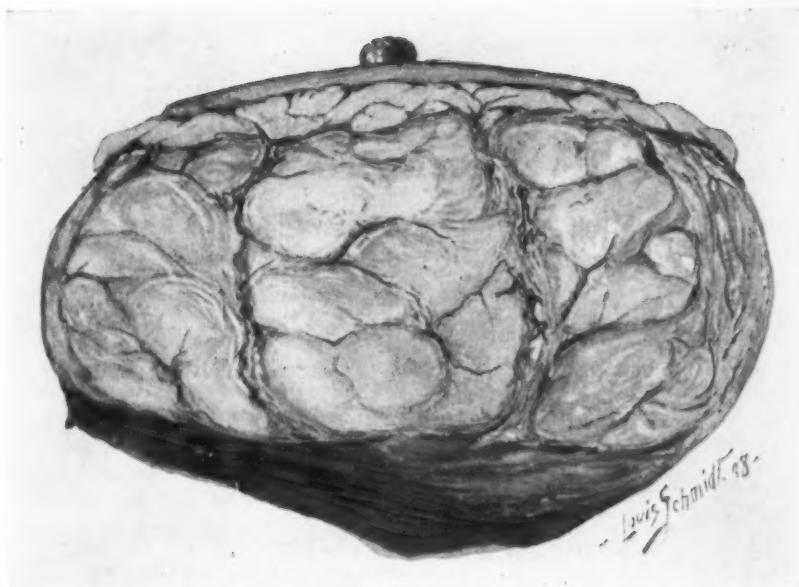
Physical Examination.—Patient is well developed for her age. General nutrition good. Examination of heart and lungs negative. Abdominal examination, negative. The right breast is enlarged, globular in shape, nearly three times the size of left. It is very hard. The skin is tense and shiny. Numerous large subcutaneous veins radiating from nipple. The nipple is flattened and partially retracted. No special tenderness. Breast is very movable on underlying tissues. One or two small glands are palpable in the axilla. (See Fig. 2.) *Diagnosis.*—Sarcoma.

Operation.—April 26, 1907, amputation of breast. Elliptical incision, greater part of skin covering breast sacrificed with it. Great vascularity of subcutaneous tissue. Pectoral fascia was cleaned from muscle, which was not removed. Thorough dissection of the axilla from below. Several enlarged glands were found. Their appearance suggestive of sarcomatous infiltration. Undermining of skin edges was necessary to closure of wound, which was accomplished except for a central area about the size of a silver dollar. Primary healing of wound. Patient discharged from hospital June 13, 1908.

Laboratory Report.—The tumor when received measured about $6\frac{1}{2} \times 4\frac{1}{4} \times 3\frac{3}{4}$ ". The overlying skin including the nipple was intact and freely movable on the tumor. The nipple showed marked retraction. The tumor mass of an irregularly moulded shape, its consistency firm throughout and of marked density. Section of the tumor showed it to be composed entirely of pale whitish glistening tissue, poorly supplied with blood. On section the tissue was arranged in rounded masses composed of whorls of glistening white striations; this appearance was continuous throughout all portions of the tumor (Fig. 3).

Histological Examination.—Blocks of tissue for examination were taken from various portions of the tumor mass, those from the surface showing a distinct fibrous capsule consisting, for the most part, of typical old connective tissue fibres. Directly beneath this capsule the tumor was made up of elongated spindle shaped cells closely packed together and arranged in whorls (Fig. 4). These cells were of the fibrous tissue type and characteristic in arrangement and number of the cells found in rapidly growing tumors composed of fibrous tissue. Numerous ducts were seen throughout the tumor, which were lined by cells of a cylindrical type, arranged in some places in one layer, and in others, in several layers. Some of the ducts showed an enlarged lumen re-

FIG. 3.



CASE II.—A section of the breast and tumor, showing the diffuse nature of the growth.

sembling cystic formation, and in such localities the epithelial lining was flattened and atrophic from pressure. In no place had the epithelium broken through the basement membrane or infiltrated the surrounding tissues. The breast tissue had practically disappeared except for the presence of these ducts scattered through the tumor; and its place and bulk were represented by the new-formed fibrous tissue.

Pathological Diagnosis.—Diffuse Fibroma. Histological examination of several small lymphatic glands showed moderate congestion and no evidence of tumor metastasis.

We have collected from the literature thirteen cases of this type, abstracts of which follow.

WEINOKOUFF.⁹—Girl 13½ years of age. Left breast noticed to be enlarged fifteen months before, but not painful. Growth stationary for ten months, when it rapidly increased until three times the size of opposite gland, no pain. Tumor occupied entire left breast, hard, size of two fists, movable. Removal of breast; cured; Diagnosis: adenofibroma.

PATTERSON.¹¹—Girl, 13 years, tumor developed seven months after injury; slow growth, no pain or tenderness, not adherent, almond sized, lobulated. Tumor removed; Diagnosis: adenofibroma.

PATTERSON.¹¹—Girl aged 12 years, noted a lump in right breast three months ago; painless. Apparently disappeared, but reappeared in one month, causing pain, and gradually growing until it was size and shape of a fig. Growth situated below nipple and not adherent, but tender and sensitive. Operation: Removal of tumor. Diagnosis: adenofibroma.

BARTON.¹¹—Girl aged 12, swelling of left breast, when first noticed was size of pigeon's egg, and painless. In two months' time was four times size of opposite breast, covered by dilated veins, lobulated, freely movable, nipple and glands normal. Operation: Removal of breast. Diagnosis: adenofibroma.

CARTLEDGE.¹²—Girl aged 16 years, right breast seat of a tumor, situated midway between nipple and axilla. Rapid in growth, painful, superficial veins enlarged. Tumor movable, size of goose egg, not adherent to gland. Operation: Entire breast removed, probably fibroma.

HOPKINS.¹³—Girl aged 11, four years previously had tumor, size chestnut, removed from right breast. Six months after operation left breast enlarged; later very rapid growth and enlargement of axillary nodes. Never menstruated. Entire breast and four nodes removed. Diagnosis: Fibroma. First tumor probably same type.

LEDOUBLE.¹⁴—Girl aged 15, rapid increase in size of both breasts following cessation of menstruation. Nipple flattened, overlying skin tense and containing large veins, pain of lancinating character, discomfort from weight of breasts. Diagnosis: Hypertrophy; under palliative treatment there was a diminution of left breast, right one increased in size and finally was amputated, weight being 1985 Gm. Microscopical examination: fibro-adenoma, preponderance of fibrous tissue.

GUENIOT.¹⁵—Observed case in a girl of 14 years, breast three times



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GUENIOT.¹⁵—Observed case in a girl of 14 years, breast three times

its normal volume, lancinating pains and enlarged nodes of the axilla were palpable. Diagnosis: not given.

HAYNES.¹⁰—Girl aged 13, developed an enlargement of both breasts about nine months before. There was slight pain on pressure, which symptom soon disappeared. Five months after the enlargement began, the left breast grew very rapidly. An examination showed that the breast extended to the ilium when the patient was standing. The nipple was flattened and the region about excoriated. The breast was freely movable on the deeper structures but was not painful and only inconvenient by reason of its weight and size. The axillary glands were not enlarged. The breast when amputated weighed exactly eight pounds, and was reported as a fibroadenoma undergoing mucoid degeneration.

PARSONS.¹¹—Child 3 years of age, enlargement of left breast noted eighteen months previously, slow growth, no pain or discharge from nipple. Mass was size of an egg, cystic in character, adherent to skin, nipple normal. No tenderness or enlarged nodes. Removal of tumor and part of pectoral fascia. Diagnosis: Cyst, containing clear fluid within and a smooth wall.

SPENCER.¹²—Boy aged 4, lump in right breast since birth, round, tense, size of pea, painless. Rapid increase in size during the last three weeks, when it became size of egg, skin normal, no discharge from nipple, no nodes palpable. Exploratory puncture gave bloody fluid. Breast amputated. Was seat of multiple cysts and a solid growth, size of hazel nut. Probably cystic fibroma.

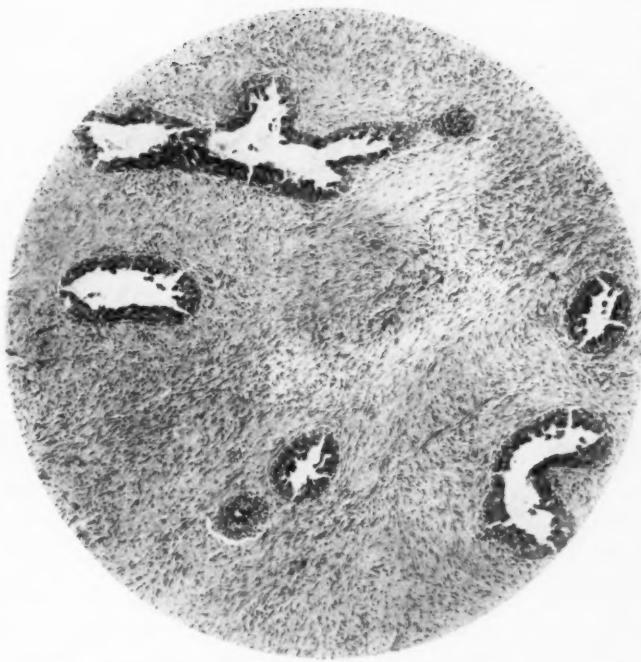
ATKINS.¹³—Records an enormous lipoma, 25 pounds, in girl of 16 years. At the age of 4 years parents noticed a slight enlargement of left breast, which increased slowly and without pain until she was 12 years old. Then tumor began to enlarge very rapidly. Right breast was normal. Catamenia have not appeared. Growth removed. Operation followed by cure. Diagnosis: lipoma.

BRYANT.¹⁴—Male, aged 10 months. Hard tumor size of walnut situated above and to outer side of left nipple, moving freely upon the deeper parts, skin adherent but not discolored. Four months before began to grow rapidly. Composed of fatty and fibrous tissue.

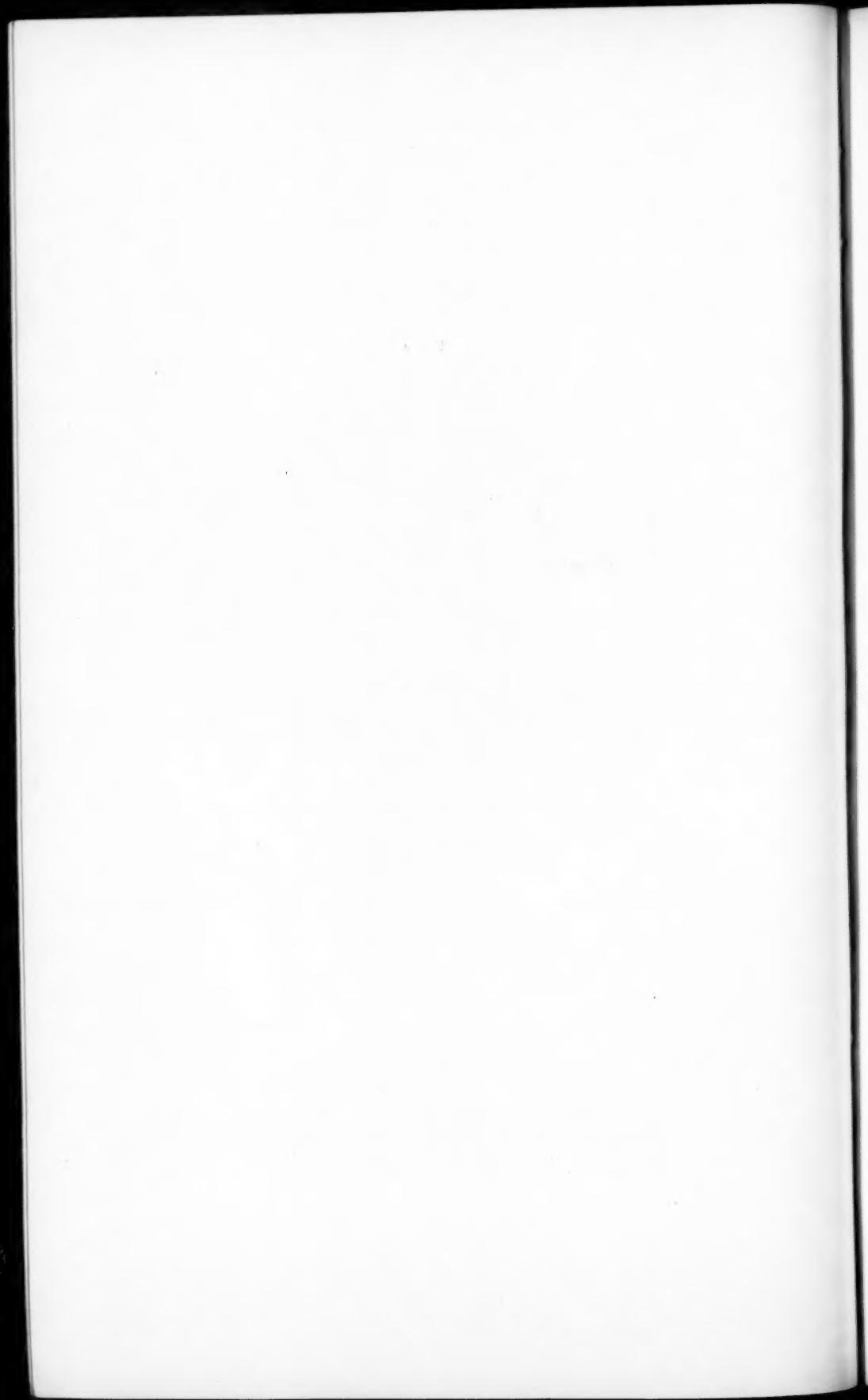
We have carefully analyzed these 21 cases of benign tumors of the breast in so far as the data, often scanty in the original reports would permit. We have made the usual age limit of 16 years. In only one of the cases in the older girls, was menstruation mentioned as having occurred, and in several others it was stated that it had not occurred.

First with reference to the type of tumor and its relative frequency. Eleven of the 21 cases can be classified as fibromata or fibro-adenomata. The dividing line between these

FIG. 4.



Histological structure of the tumor in Case II. It is made up for the most part of elongated spindle-shaped cells arranged in whorls.



two types of tumor if it exists at all, is a very indefinite one and we are inclined to follow the classification of Ribbert as adopted by Warren, Rodman and other writers on this subject, and consider them as fibro-adenomata. They constitute the most numerous of any type of tumor of the breast occurring in childhood, and their proportion to the total number of benign breast tumors is higher in children than in adults. There were six angioma, one fibro-lipoma, one lipoma, and one simple cyst; in one case the diagnosis was not given. Fourteen of the cases were in females, five in males and in two the sex was not stated; these were probably females. In three of the six cases of angioma the tumor was in boys. In this as in other respects, angioma are practically in a class by themselves as regards their occurrence, pathology and symptomatology.

Age.—Most of the angioma were noted at birth or soon afterward; the children, however, were often half-grown before being brought for surgical attention. The oldest was 12 years and the youngest 15 weeks. Of the other tumors, with three exceptions, the cases were 10 years old and upward. These three cases were aged 10 months, three and four years respectively; the other cases ranged between 10 and 16 years. One was 10, two were 11, two 12, three 13, one 14, one 15 and two 16 years.

The *duration* ranged from two months to 12 years. In some cases the growth were distinctly rapid from the start, but not infrequently they were of gradual development or showed a rapid increase after a long stationary period.

As already stated the angioma were commonly congenital or appeared in infancy.

As to *causation*, in one case there was a history of traumatism before the appearance of the tumor, and in another case, an angioma, there was rapid increase in the size of a congenital tumor following injury.

Breast involved.—In 9 cases the right breast was the seat of tumor, in 7 the left breast was affected, in two both breasts, and in three the location was not stated.

Location of the tumor in the breast.—But little data was

furnished in this respect. The growth was stated to be below the nipple in two cases, and twice in the outer quadrant.

In some cases the entire breast was involved, while in others the tumor was of a localized nature, and it was difficult from many of the case reports to state to which of these two classes the case should be assigned. In at least nine cases practically the entire breast was involved. *Size*.—The largest tumor (Atkins¹⁴) was a lipoma which weighed 25 pounds. In Le Double's¹³ case the tumor weighed between 4 and 5 pounds (a fibro-adenoma), and in Haynes⁸ case (a fibro-adenoma undergoing mucoid degeneration), it weighed 8 pounds. Several times the tumor was said to be 3 or 4 times the size of the opposite breast. The smallest growths were the size of a walnut, almond or egg and were seen to be of a localized nature.

In practically every instance the tumor, or if the whole breast was involved, the breast was said to be movable. In two of these cases the skin was not adherent.

Nipple.—The nipple was retracted in several cases, flattened in two and said to be normal in one. The skin is usually normal except for the presence of dilated veins which are not uncommon. Dilated veins were described as being present in five cases, two of which were angioma. In our own case, in addition to this enlargement of the veins, the skin was tense and shining; in one case of angioma it was said to be discolored.

Pain and Tenderness.—In six cases pain or tenderness or both were mentioned as being present, sometimes sharp and lancinating. In four cases pain was said to be absent, and in the remaining instances it was not mentioned.

Lymph Nodes.—These were enlarged in 3 cases, not enlarged in 5 cases, and not mentioned in the remainder.

Operation.—In 11 cases the entire breast was removed, and in two the axilla dissected free of enlarged lymph nodes. In 8 cases the tumor was excised, once including the nipple. In one case no treatment was instituted and in one it was not mentioned.

Result.—So far as known all the cases operated upon were cured.

MALIGNANT TUMORS. CARCINOMA AND SARCOMA.

The number of malignant tumors of the breast which have been observed in childhood is small. This is what might be expected in the case of carcinoma the rarity of which is well known in childhood. It is doubtful if any well authenticated case of carcinoma of the breast under sixteen years of age has been reported and Gross states that it does not occur under the age of 20 years.

P. W. Phillip²⁸ in his article "Ueber Krebsbildungen in Kindersalter," collects 390 cases of cancer reported as occurring in childhood. Of this number only 87 (22.3 per cent.) withstood critical examination as to their nature, the remainder being doubtful cases. This is sufficient to show the rarity of cancers in childhood. Phillip did not find a case of mammary carcinoma under 15 years, and only one case of cancer of the uterus, while 26 cases of ovarian cancer were observed. There seems to be a relative predisposition of the ovaries to malignant disease in childhood, furnishing 20 per cent. of all cases of cancer, while in adult life they furnish but 5 per cent. at the highest estimate. We have found but three cancers of the breast in children, and all of these cases are doubtful in nature, and reported many years ago. They are as follows:

1. LYFORD.²⁹—A case in a girl of 8 years. (Mentioned in John Birkett's article, "Diseases of the Breast," in Holmes' System of Surgery, vol. iii.)
2. B. B. COOPER.³⁰—Lectures on Surgery, 1851, reports a case which he thought to be cancer in a girl of 13 years. The tumor was rapid in its development, painless, and accompanied by cachexia and metastasis to the thoracic and abdominal viscera. (This may have been and probably was a case of sarcoma.)
3. BIRKETT.³¹—Mentions a specimen in the Museum of St. Bartholomew's Hospital, removed from a girl of 16 years.

SARCOMA.

This also is a rare disease of the breast in children. While a number of references are contained in the literature, very

meagre descriptions of the histological structure of the supposed sarcomata are furnished. Gross²⁹ states that 1.66 per cent. of cases of sarcoma of the breast occur during the developmental stage, that is, before the sixteenth year. Karelowski³¹ collected 156 cases of sarcoma of the breast of which 1 occurred before the tenth year and 14 before the eighteenth year of life. There is no doubt that sarcoma is a much rarer tumor of the breast than was supposed by the older writers, a fact recently emphasized by Rodman³⁰ in his work on "Diseases of the Breast." Instead of 5 to 9 per cent. of mammary tumors he estimates its frequency from an analysis of 5000 cases at 2.78 per cent. The relative liability of the female breast to sarcoma is below that of the body in general and while, heretofore, it has been generally assumed and stated that it was a disease of young women, it is a fact, as Rodman points out, that one-half of the cases occur between the ages of 40 and 50 years. Two explanations may be furnished to reconcile the disparity between the figures of the older writers, as Gross, and those of the present day. The commonly accepted one is that a more accurate histologic diagnosis is now insisted upon and that the microscope is relied upon more than the clinical picture. Another explanation which has occurred to us is, that the great increase in recent years in the number of cases of cancer of the breast, as of cases of cancers of all kinds, has not been accompanied by a relative increase in the number of cases of sarcoma of the breast.

Types of Sarcoma Found in Childhood.—Generally speaking, spindle-cell tumors develop at an earlier age than do round-cell tumors, while cystic sarcomas are observed more frequently in youth. It may be difficult to diagnose between a rapidly growing fibroma and a spindle-cell sarcoma. Thus in our second case diagnosed before operation as sarcoma, several experienced pathologists made a diagnosis of sarcoma, from some of the microscopic preparations which apparently confirmed the clinical diagnosis. The liability to error before operation is not inconsiderable, for our second case presented the clinical picture of a rapidly growing sarcoma, the diagnosis being based

upon the rapid growth of the tumor, its general appearance and the presence of the distended veins in the overlying skin, an appearance which is common to sarcomata in general. A review of the cases here collected will show, however, that this latter symptom is described as present in a number of cases of non-malignant tumors of the breast in childhood both of angiomatic and fibro-epithelial origin. The following are the references to sarcoma of the breast. Scant details are furnished in the original reports.

1. SHEILD.²²—A rapidly growing spindle-cell sarcoma in girl of 14 years.
2. SHEILD.²³—A myxo-sarcoma removed from the breast of an infant aged six months.
3. CHAMBERS.²⁴—A four months old child presented a small round-cell sarcoma of the breast the size of an egg. Duration, since 5 weeks. Removed. No recurrence at the age of five months.
4. BILLROTH.²⁵—A child of 9 months. Sarcoma of breast. Removal.
5. HANSEY.²⁶—A case seen at an early age.
6. RODMAN.²⁷—A girl aged 11 years gave a history of traumatism one year before development of the tumor. Pain in breast was followed by an increase in size, the growth being fairly hard. Removal was advised on account of increased pain, and the presence of enlarged veins in the overlying skin; which the author believed indicated the tumor to be of sarcomatous type. Breast was removed. No enlarged glands were found in the axilla. Microscopic examination not made, specimen being lost.

The diagnosis was based on what may have been misleading clinical symptoms. The presence of the enlarged veins is not conclusive evidence of malignancy as shown in our own case and in several of the vascular and fibro-epithelial tumors which have been collected in this series.

CONCLUSIONS.

Tumors of the Breast.—While rare in childhood, occur in both sexes and at all ages.

The benign tumors are more frequently encountered in the mammary gland in early life than the malignant tumors. The fibro-epithelial growths are the most numerous group of the benign tumors, and next to these in point of frequency come the angiomata.

Sarcoma may occur in children in the mammary gland, but it is a rare tumor. The breast enjoys almost complete immunity to carcinoma before the age of puberty.

Girls are affected more frequently than boys, but the disparity in numbers is immensely less than in adults.

The angioma are commonly congenital, or first appear in infancy. The fibro-adenomata tend to develop more frequently as the child approaches puberty.

Some of the smaller benign tumors occasion no inconvenience. Others are associated with symptoms, pain, tenderness, and inconvenience or discomfort from excessive weight or size. Sarcomata present the symptoms common to that type of tumor.

Operation is usually indicated in the benign and always in the malignant varieties. In small benign tumors or those involving only limited areas, conservative plastic operations with preservation of breast and nipple are indicated. In a goodly number, however, the breast must be sacrificed. The axilla should be cleaned if it contains enlarged glands. The results of operation are good.

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BILIARY CALCULUS WEIGHING TWO AND ONE
HALF OUNCES REMOVED FROM THE
COMMON DUCT.

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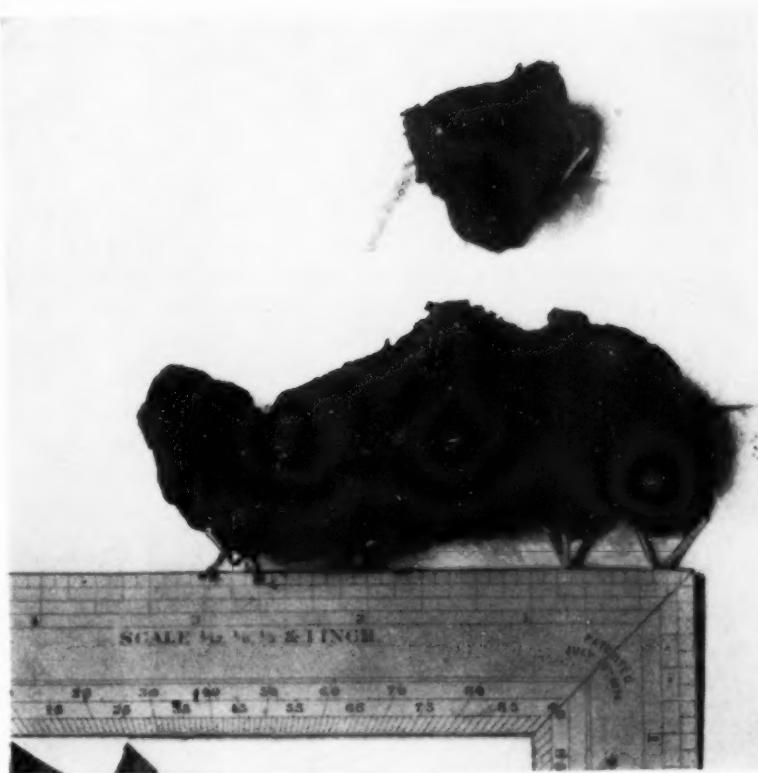
THE object of the present communication is to place on record the successful removal of a common-duct stone larger than any which the author has been able to find hitherto recorded.

The possessor of this remarkable stone was a man forty-five years of age, born in Ireland, the proprietor of coal mines.

He had suffered from indigestion for twenty years, during which time colicky attacks in the right upper abdomen had been frequent. Sometimes the interval between was as long as six months, sometimes not longer than one week. There had usually been a chill and high fever accompanying the attack, and after this had subsided he had generally become jaundiced and later been troubled by intense itching. Usually he was so ill he had to go to bed and have morphine for the pain. Vomiting, which was common, had very little effect as far as relief of the suffering was concerned.

The region of the gall-bladder is distinctly sensitive. The skin and scleræ are tinged a deep yellow. The pulse is slow and there are marks of the finger-nails to be seen all over the body. Dr. Hugo Summa, who referred the patient to me, was able with bimanual examination to palpate a hard mass in the right abdomen at about the usual site of the common duct. (This mass proved to be the stone: it must be very rarely possible to palpate a common duct stone *in situ*.)

Operation January 2, 1906. The gall-bladder was considerably distended, contrary to the law of Courvoisier, and contained thousands of tiny stones together with much sand and stinking bile. The common duct was of such size and thickness that we at first mistook it for some other organ or new growth. When,



Calculus removed from *ductus choledochus communis*.



however, it was incised an immense stone was found and broken during removal. The hand of the operator could be introduced into the cavity which was left. One peculiarity about this duct was that it had not dilated symmetrically but to the right side of its axis. The immense opening was sutured up to a large rubber tube which was left for bile drainage. Strips of gauze were tied to the stitches and a rubber tube was inserted through the back.

The patient's convalescence was rather protracted on account of suppuration in the abdominal wound, but he made an ultimate excellent recovery and was walking about the hospital one month after the operation. I saw him five months after when in splendid health and weighing more than he ever had in his life before. About a year later I learned that he had died but could not determine any further particulars.

This unusually large calculus weighed two and one-half ounces when removed. It is four inches in length by one inch and a half in breadth. The chemical examination of it made by Dr. Rush shows its organic constituents to be as follows:

Cholesterine, making up a large proportion of the substance; bilirubin, also in large amount; urobilin, trace; sodium, potassium, calcium, magnesium, copper and iron (manganese indicated in preliminary but not confirmed); carbonic, sulphuric, hydrochloric, nitric, phosphoric and silicic acids.

ACUTE DILATATION OF THE STOMACH COMPLICATING TYPHOID FEVER.

BY CUNNINGHAM WILSON, M.D.,

OF BIRMINGHAM, ALA.

ACUTE dilatation of the stomach is a condition receiving at the present time no little attention. I have been unable to find in the literature at my command a report of this condition occurring as a complication of typhoid fever. I report below such a case, which I think of enough importance to call to the attention of the profession.

Miss T., age 22, suspected typhoid perforation. Acute dilatation of stomach. Exploratory laparotomy; recovery. This patient was admitted to St. Vincent's Hospital under the care of Dr. H. S. Ward, on March 30, 1907, at the end of the first week of typhoid fever. On admission her temperature was 103, pulse 100. On the day after admission, the patient had a small hemorrhage from the bowels. With the exception of the fact that she did not take her nourishment well, there was nothing unusual up to April 14, when she began to complain of considerable abdominal pain. This was accompanied by a slight degree of tympany. Pulse ranged from 110 to 120; temperature 102. Patient vomited occasionally. After giving $\frac{1}{4}$ gr. morphine hypodermically, these symptoms became less in intensity.

April 15. Patient had another attack of abdominal pain. Vomiting at frequent intervals. Tympany much more marked. At 3 P.M. patient's condition was extreme; temperature 102, pulse ranged from 110 to 140 and was irregular in rhythm. Abdomen markedly distended. Abdominal respiration absent through abdominal muscles not definitely rigid. Operation April 15. Under ether the abdomen was opened and found entirely filled with what proved to be a distended stomach. The lower portion of the stomach was tightly wedged in the pelvic cavity and its upper border was found high up in the epigastrium. A stomach-tube was introduced and a large quantity of gas and bile-stained fluid, containing a large amount of mucus was removed. The stomach

now became collapsed and resumed its normal position. Before removing the tube, the stomach was washed out until the fluid returned clear. The abdominal cavity contained a considerable amount of serous fluid. This was carefully mopped out. A quart of normal salt solution was now poured into the cavity and the wound closed without drainage. During the next few days the stomach was washed out several times. The patient made an uneventful recovery. This case was not, strictly speaking, a surgical condition, but the diagnosis was not made before the exploration.

ACUTE HÆMATOGENOUS INFECTION OF ONE KIDNEY IN PERSONS APPARENTLY WELL.

A REPORT OF EIGHT CASES.

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It is not well understood as yet by the profession that in persons apparently in good health septic infarcts of the kidney may be caused by bacteria, usually colon bacilli, circulating in the blood, and that the acute cases of this form of hæmatogenous infection can present a typical picture of certain of the grave abdominal emergencies,—appendicitis, cholecystitis or visceral perforation, with abdominal tenderness and rigidity, vomiting, high pulse, temperature and leucocytosis.

Only a few cases have been reported and several have been diagnosed incorrectly before operation. Among the earliest cases reported was one by A. T. Cabot, of Boston, in 1901, in an article entitled *Idiopathic Abscess of the Kidney*. Dr. Brewer, of New York, has done much to call attention to this subject. My first case was operated upon in 1903 and reported in 1907.* The disease is one of great interest and I am convinced that many more cases must be reported and the whole question discussed with emphasis before medical men in general are made to realize that such a condition can occur and that its proper diagnosis and treatment are matters of the utmost importance. For this reason I wish to report here eight cases from the surgical wards of the Massachusetts General Hospital, all of them operated upon since 1902. Dr. F. B. Harrington and Dr. W. M. Conant have very courteously given me permission to report their cases with my own. Six

* *Acute Hæmatogenous Infection of one kidney in persons apparently well. Report of a case and a study of the subject.* Boston Med. and Surg. Jour., Jan. 24, 1907, clvi, No. 4, 97.

of the cases have been shown by me at meetings of the Staff of the Hospital and also by invitation at the meeting of the American Society of Clinical Surgery in May last.

These infections while comparatively rare are not so infrequent as past experience would show. In all probability they have not been recognized in the early stages of the infection. My own experience since 1902 includes six cases, one of them operated upon twice, and in the four months from October to February last two cases were operated upon by Dr. Conant, one by Dr. Harrington and three by myself. The records of the above mentioned hospital for 20 years, from 1883 to 1903, however, show only four cases of operation for undoubted hæmatogenous infection of the kidney, in three of which infection occurred without known cause while the individual was in a condition of good health. Johnson analyzed all the cases of surgery of the kidney at the Roosevelt Hospital for eight years preceding October 1, 1898. There were twelve cases operated upon for abscess of the kidney, all but three of which had an undoubted origin in ascending infection and pyelitis. In only three cases was it at all probable that acute hæmatogenous infection of the kidney had been the origin of the abscess.

Infection of the kidneys may be ascending, the urogenous type, or an infection from the blood, the hæmatogenous type. It may take place also through wounds or by extension from other abscesses in the immediate vicinity of the kidney. In any condition where bacteria are plentiful in the blood stream or in general infectious diseases or where local sepsis exists, hæmatogenous infection of the kidney can occur provided conditions favor it. This infection may be mechanical by actual minute bits of infected tissue carried to the kidney and arrested in some of the terminal vessels. This is the commonest form of hæmatogenous infection and is to be expected in extensive suppuration elsewhere, in septicæmia, pyæmia, ulcerative endocarditis and the like. These true embolic infections usually involve both kidneys, and in the pre-antiseptic days when septicæmia and pyæmia were common, were a frequent cause

of death. The infection, however, may be by bacteria themselves which are circulating in the blood and for some reason lodge in the terminal vessels of the kidney. This infection usually involves only one kidney, and while it may occur in any of the septic conditions mentioned or in infectious diseases, it is of the utmost importance to know that it does occur much more frequently than is realized in persons previously in apparent perfect health.

These infections are interesting clinically and also from a bacteriological standpoint. The right kidney is said to be more frequently involved than the left. No explanation for this has been found. In the cases reported here the right kidney was infected in five and the left in three cases. When an acute infection of the right kidney occurs the symptoms may suggest exactly acute appendicitis or acute cholecystitis (see Cases III and VII). More cases occur in women than in men and especially in those who have borne children. Only one of the eight cases herein reported was a man. Four of the women had borne children.

In persons apparently well the onset is usually acute and without warning. The course of the disease may be rapid, with increasing toxic symptoms, or after an acute onset the patient may go for weeks or months in a septic condition. The very acute cases are the ones which simulate most closely abdominal infections. On the contrary in a small number of cases infection may manifest itself by slight pain in the back and a long continued fever with or without pyuria, which symptoms may never lead to a suspicion of the kidney. In the existence of septic conditions elsewhere or infectious disease, it is easier to suspect an infection of the kidney than when such symptoms come without warning. It should be understood also that in any condition of health or disease bacterial localization may take place in one or more of the terminal vessels of the kidney causing at the time very slight symptoms, but that such cases can go on to more or less extensive abscess formation without rupture of the abscess or abscesses into the kidney pelvis or into the perirenal tissue.

In advanced stages of renal abscess it is difficult if not impossible to decide whether the infection came through the blood or lower urinary tract. In the course of some other disease bacterial infection of one kidney may never be recognized as a complication. Many of the large lumbar abscesses following typhoid and other infectious diseases may originate in such focal abscesses in the kidney cortex with late perforation into the perirenal tissue.

Before proceeding further with the discussion of the subject, I will give a history of one of the acute cases somewhat in detail in order to illustrate the striking similarity of such cases to acute abdominal infections and to emphasize the uncertainties of diagnosis.

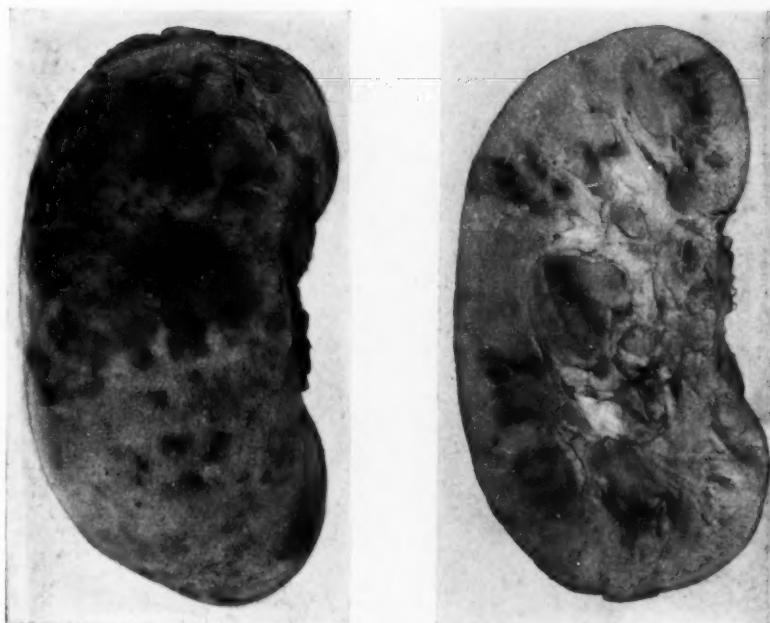
CASE I. (*Fulminating case simulating gastric or duodenal perforation. Operation 26 hours after first symptoms. Infection colon bacillus.*) Rose H., 23 years old, married, saleswoman by occupation, white, entered the hospital through the accident room December 7, 1907. Aside from children's diseases her previous history was unimportant. She had been married three years, and but for slight irregularity in menstruation and some leucorrhœa and occasional "nervous attacks," had considered herself well. She had had no children and no miscarriages. Up to a few months before she was constipated; since then the bowels have been loose, about three movements a day. She had noticed nothing unusual in the character of the movements. For three weeks previous she had not felt as strong as usual and had been somewhat drowsy and stupid. She did not consider herself sick, however, and was able to work every day. Twenty-four hours before entrance while at work in the store, she was seized with a sharp stabbing pain in the abdomen, especially on the left side high up, it was so severe that she fainted. The pain increased in severity and became general over the abdomen. The most severe pain was described as starting just below the ribs on the left radiating into the left groin. She required large doses of morphia during the night. The pain continued with increasing severity, accompanied by hard chills and frequent vomiting. After entering the hospital she had two severe chills and vomited several times.

Examination.—A fairly well-developed and nourished young woman, somewhat anæmic, evidently very sick. Nothing abnormal found in the heart or lungs. The abdomen was everywhere extremely rigid and tender, the greatest amount of muscular spasm, however, was in the left hypochondrium. There was marked tenderness in the costo-vertebral angle on the left. Vaginal examination showed some tenderness and increased resistance on the left of the uterus, but no mass could be felt. The uterus was normal in size and freely movable. Temperature, 104° F. Pulse, 140; poor quality. Leucocytosis, 26,000. Examination of urine showed no pus, blood or albumin. Neither kidney could be palpated, but attempts to palpate the left kidney caused exquisite tenderness anteriorly and posteriorly. While the symptoms and signs pointed with definiteness to an acute abdominal infection, probably gastric perforation, the marked tenderness in the costo-vertebral angle made me consider an infected kidney, yet because of the positive abdominal signs and the absence of blood and pus in the urine it seemed wise to make an anterior incision first.

A short incision through the left rectus muscle above the umbilicus was made and the abdominal cavity opened. There was no evidence of peritoneal infection. The right kidney was normal in size and position. The left kidney was found to be enlarged and the perirenal tissue œdematosus. The anterior wound was rapidly closed and the left kidney cut down upon through an incision in the flank. It was covered with characteristic small dark and yellow spots, the multiple septic infarcts. The kidney was removed, the renal vessels having been tied with silk. A gauze drain was left in and the wound closed about it with chromicized catgut and silkworm gut. One pint of salt solution was given intravenously before the patient left the operating room.

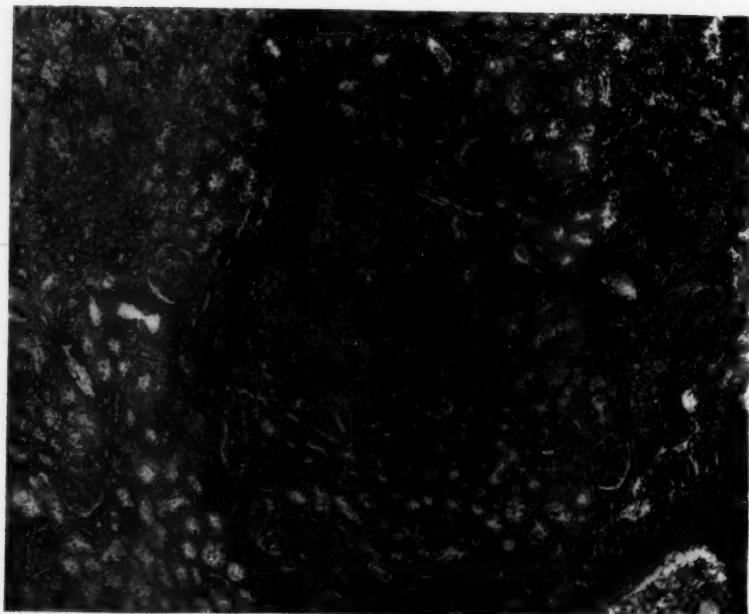
The patient made a prompt and satisfactory recovery. Twenty-four hours after the operation the temperature had dropped to 100° F. and the leucocyte count to 16,000. Three days after the operation the temperature was normal and the leucocyte count 7000. The wound drained a large amount of rather foul pus for two weeks, after which it healed without incident. The other kidney performed its functions perfectly;

FIG. 1.



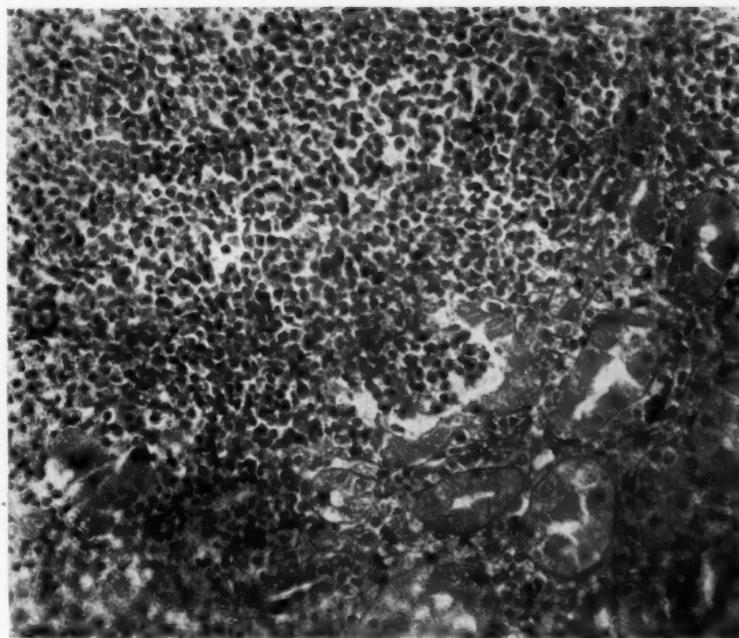
Acute case simulating gastric perforation. Operation 26 hours after first symptoms. Figs. 2 and 3 are sections through one of the infarcts in this kidney. (Specimen from Case I.)

FIG. 2.



Acute septic infarct in cortex under low power. (Section from kidney shown in Fig. 1.)

FIG. 3.



Border of the same infarct under high power. Note beginning disintegration of one of the tubules.



at no time was there active or passive congestion. The cultures from the infarcts showed pure colon bacillus infection.

This patient has remained well. The appearance of the infected kidney in this case is shown in Fig. 1, and in Figs. 2 and 3 are shown microscopic sections from one of the infarcts under high and low power.

The chief points of interest in this important condition are the cause, the source and kind of infection and the diagnosis. Some abnormality in the kidney or ureter is the probable cause of the arrest of the bacteria. The infecting bacteria are almost always arrested in the terminal vessels of the cortex close to the fibrous capsule. The blood vessels become choked with microorganisms. Blood passes into the interstitial tissues and in this stage of infiltration, the earliest stage, the infected areas resemble true hemorrhagic infarcts. As the infection goes on a true abscess is formed, separated from the sound tissue by a hemorrhagic margin. The infected areas then resemble minute pus points or septic infarcts. The condition has been aptly named by Dr. Whitney, Surgical Pathologist to the Massachusetts General Hospital, "*focal suppurative nephritis*." (Figs. 1, 4 and 5 show remarkably well the appearance of the infarcts in various stages.)

The following paragraphs on the etiology and pathology as far as the heading "Diagnosis" are with certain modifications taken from my previous article.

The kidney can be infected through the blood by a variety of organisms. Infection carried by true emboli would be the same infection as the focus from which the emboli started. The common microorganisms of pus, the streptococcus and staphylococcus, the typhoid bacillus, Friedländer's diplococcus, the bacillus of diphtheria, the bacillus pyocyanus and the pneumococcus have all been isolated from renal abscesses. The most frequent infections are undoubtedly due to the colon bacillus and to pus organisms. It is to be emphasized that the colon bacillus causes by far the greatest number of infections and that these infections are usually pure infections; this is

true no matter whether the source is the blood or the urinary channels.

No mention will be made in this paper of infection of the kidney through the blood by tubercle bacilli. The subject of tuberculosis of the kidney is one that demands special consideration. Infection by the gonococcus is seldom, if ever, a pure infection, and so far as is known is always the ascending form and not an infection through the blood. Herszky, however, states that while gonococcus infection of the kidney is an ascending infection and usually mixed, he can refer to a few cases of renal abscess in which the specific organisms of gonorrhœa were found which probably came from the blood. Le Fur has reported a case of probable haematoogenous infection by the gonococcus.

Until recently it was thought that when large numbers of bacteria were in the blood, whether through general septicaemia or in some diseases, as diphtheria, or experimentally by injection into the veins or peritoneal cavity, most of the bacteria passed through the kidneys and were eliminated by the urine, and that the chance of disturbing the functions of the kidneys was great. Recent experimental research, however, seems to prove that the majority of the organisms introduced into the circulation are destroyed before reaching the kidneys, and that while many bacteria are eliminated by the urine it is unusual for bacteria to lodge in the kidney if the kidney and ureter are normal. The researches of Buxton and Torrey in the laboratory of experimental pathology of Cornell University, as well as the work of Metchnikoff and Canon, seem to prove this absolutely. It is doubtless true that one of the functions of the kidney is to excrete bacteria which have gained access to the circulating blood and have not become destroyed before reaching the kidney. Microorganisms may be excreted by the kidneys without injuring them in any way. The finding of bacteria in the urine, as in typhoid fever, does not necessarily mean renal infection, only that certain of the bacteria from the general disease or from distant septic foci have passed through the kidneys.

Sampson, of Johns Hopkins, performed a series of experiments on dogs in which he tied the ureter of one kidney and injected pure cultures of staphylococcus into the jugular vein. He found that bacteria were eliminated to a certain extent by the urine, but only in those cases in which he tied the ureter did the kidney become infected. Brewer, later in a series of experiments on dogs, found that not only obstructing the ureter but bruising the kidney caused infection.

The colon bacillus is the most frequent form of urinary infection, whether of the kidney or of the bladder. It is now well known that the colon bacillus, under certain conditions, has virulent pathogenic properties; that it is a true pyogenic organism. The intestinal canal, particularly the lower intestine, swarms with different varieties of this bacillus. Under normal conditions of the intestinal mucous membrane the intestines do not absorb the bacillus or its toxins, but it is known that when a break in the intestinal mucous membrane occurs, and also in severe and long continued constipation, the bacteria pass through the intestinal walls in large numbers. Therefore, as an explanation of the source of infection in persons in previous good health, it may be fairly stated that not infrequently in the life of an individual the blood is infected by quantities of colon bacilli, which have been taken up because of some slight defect in the lining epithelium of the intestinal canal, or during an attack of obstinate constipation. Whether these infections result in pathologic conditions elsewhere will depend largely upon the general good health of the individual and upon the conditions of the various organs in the body.

The bladder, prostate gland and the uterus and its adnexa are additional possible sources of bacterial infection of the kidney through the blood. The blood vessels of the kidney communicate with those of the bladder, aside from the general circulation, through two other channels, the utero-ovarian and the vessels of the ureter itself. By injection experiments Sampson demonstrated that free arterial anastomosis exists between the branches of the renal artery supplying the capsule of the kidney about its lower pole, the kidney and the branches

of the ovarian artery. The ovarian artery anastomoses freely with the uterine and with the vesical. There is both venous and arterial communication. Attention should also be called to the fact that the lymphatics, especially the glands, may act as intermediary channels between the primary focus in the bladder and the general circulation. The lymphatic communication through the bladder to the kidney is indirect through the local glands of the bladder. It is, therefore, an anatomical possibility for an ulceration or septic focus in the bladder, uterus or its adnexa to infect the kidney by way of the general circulation or through anastomotic channels directly. It is doubtful whether direct infection through the blood vessels of the ureter ever occurs.

The infection in all the cases reported in this paper was *colon bacillus*. The work of Sampson, Buxton and Torrey and Brewer has proved that in normal conditions of health and normal kidneys bacteria will pass through the kidney without causing harm; that some abnormality in the kidney or its ureter is the reason for the arrest of the bacteria. The kidney may have been injured by a fall or blow upon the loin. Two cases from the records of the Massachusetts General Hospital have a history of blow over the kidney from four weeks to two months before the infection. The kidney may be prolapsed or rotated on its axis so that its circulation is deranged. Small stones are in my opinion a not infrequent cause of these infections. This series of cases furnishes some information in regard to the influence of calculi. In two of my acute cases small stones were found embedded in one of the calices, in one a very small calculus on the floor of the bladder was discovered by the cystoscope, in a fourth case a nephrectomy for stone had been done a year previously (see Cases I, III, V, VI, VIII). In all probability a frequent cause is an abnormality of the ureter due to stricture, the result of inflammation or calculi; in women deformities in the ureter caused by pregnancy or childbirth. It can not be stated, however, that such infections never take place in lowered general vitality with or without abnormalities in the kidney or its ureter. Infection,

so far as known, usually comes from the intestinal canal, although it may come from the reproductive organs and lower urinary tract in the female, especially in those cases where old pelvic disease with intestinal adhesions is present.

Diagnosis.—In the acute fulminating cases there may be nothing pointing to the kidney except tenderness in the costovertebral angle,—this I have found to be a constant sign. These acute cases present an exact picture of an acute abdominal infection,—sudden abdominal pain, tenderness, muscular spasm, vomiting, high temperature, pulse and leucocyte count. In such cases, unless blood and blood casts, with or without pus, are found in the urine, or an enlarged and tender kidney can be palpated, a positive diagnosis cannot be made. In the presence of septic conditions elsewhere or in general infectious diseases such an acute picture should always lead to a consideration of acute infection of the kidney. Fortunately the majority of the cases furnish some positive evidence either in the urine examination or by palpation of the kidney. In the less acutely sick cases the condition of both kidneys should be studied by ureteral catheterization and X-ray. In all but two of the cases reported here there was some sign which pointed directly to the kidney, and time could be taken for cystoscopy and X-ray. In certain of the cases the pain may be referred entirely to the region of the appendix or gall-bladder. In Case I the symptoms and signs were exactly those of duodenal or gastric perforation; in Case VII of appendicitis. The examination of the abdomen may give all degrees of tenderness and muscle spasm. Leucocytosis is always high in the acute cases, 18,000 to 36,000. The differential diagnosis in the acute cases, unless the kidney is enlarged and tender or the urine shows blood and blood casts and pus, will always be difficult if not impossible. It is the writer's opinion that in acute cases in which positive evidence of the kidney cannot be obtained, it is better to make a preliminary anterior incision to settle the diagnosis and the existence of the other kidney as quickly as possible. Delay even long enough for ureteral catheterization may be dangerous.

The presence of albumin, pus and blood in the urine, associated with tenderness in the costo-vertebral angle and a high white blood count should point to the kidney as the cause of the acute symptoms in persons previously in apparent good health. There should be little difficulty in diagnosis if in addition to the signs and symptoms just mentioned an enlarged and tender kidney can be felt. In the exceptional fulminating cases where nothing is found by palpation or in the urine, especially when the right kidney is infected, a positive differential diagnosis cannot be made without operation.

In all but two of the cases the urine showed albumin, pus and blood. The blood was microscopic in all the cases. Brewer states that all but two out of thirteen of his cases showed pus and blood in the urine and in one case there was enough blood to color the urine. This large amount of blood I have never seen.

Case I, reported above, is an illustration of the fulminating cases in which no positive diagnosis can be made without operation. The following is an example of the cases that are less acute in onset and in which definite signs pointing to the kidney can be found and a diagnosis made with a fair degree of accuracy.

CASE II. (*Operated upon 16 days after the first symptoms. Right kidney removed. Infection colon bacillus.*) Mrs. M. E. S., 34 years old, married, white, entered the hospital October 21, 1907. This patient was never strong. In the last fifteen years she had been operated upon three times for tuberculous glands in the neck and axilla. The last operation was in March, 1900. She had had one child seven years ago. Five years ago she had a miscarriage. Three weeks before admission she again miscarried and was curetted at another hospital, but was up and about at the end of a week and considered herself in better health and strength than for two or three years. Five days before admission she was awakened at night with a severe pain in the region of the appendix. She called her own physician, who told her that her temperature then was 103° F. and the pulse 110. During the following week the pain gradually subsided and her general condition improved, although she remained in bed.

FIG. 4.

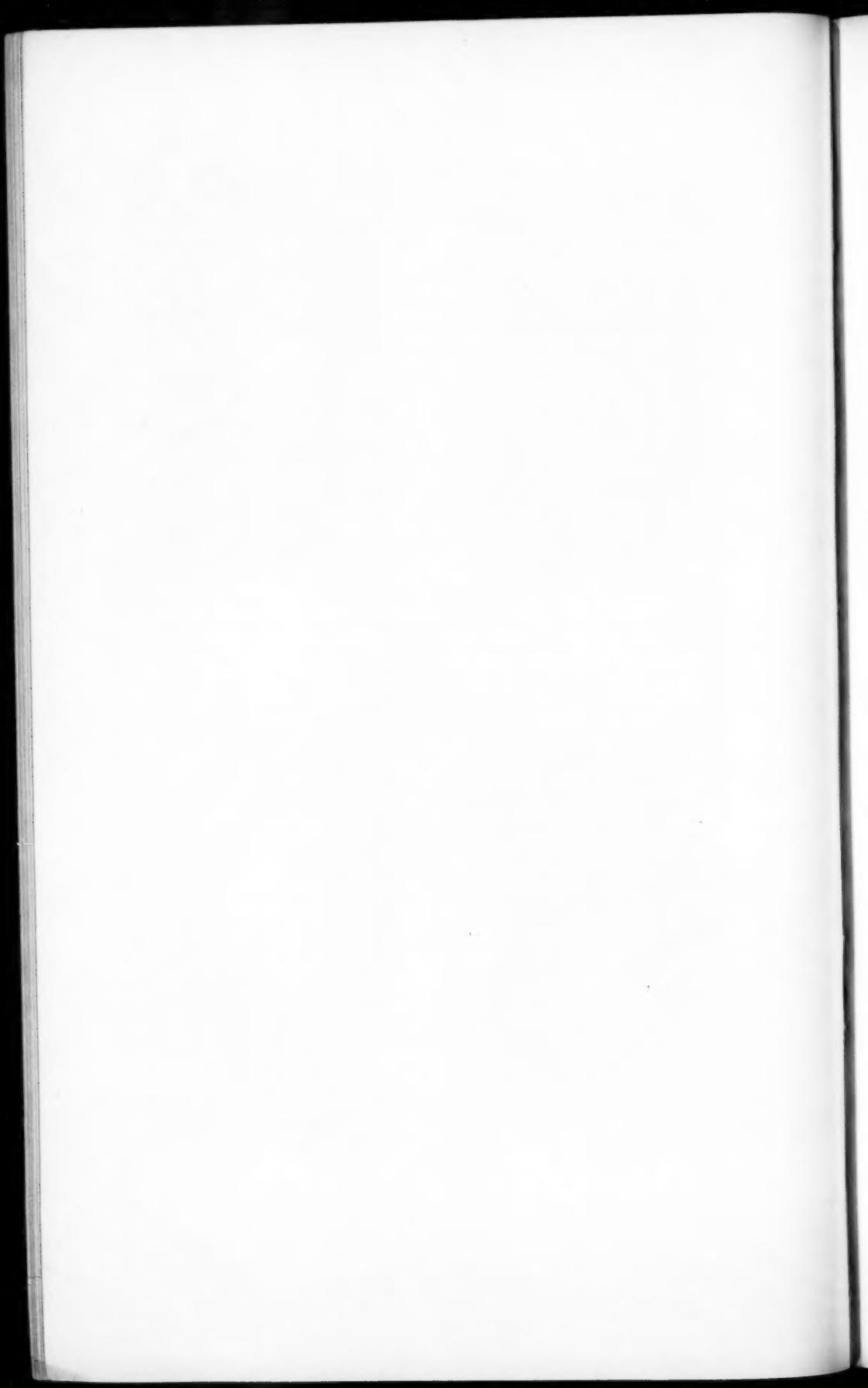


Operation 16 days after first symptoms. Compare size of infarcts with those in Figs. 1 and 5.
(Specimen from Case II.)

FIG. 5.



Acute case simulating appendicitis. Operation 4 days after first symptoms. (Kidney from Case VII.)



Examination.—Thin, poorly nourished woman. Temperature on the day of entrance was 101° F. and it varied between that point and 99° F. until the acute attack six days afterward. Pulse 110, fair strength. On each side of the neck were healed scars. One or two small glands could be felt above the clavicles. The left kidney could not be palpated. The right kidney was distinctly enlarged and movable and slightly tender. Nothing abnormal was found in the abdomen. No tenderness or muscle spasm could be made out *at this time*. Vaginal examination found nothing abnormal. X-ray plates of both kidneys showed no shadow of stone. Cystoscopy and ureteral catheterization by Dr. Lincoln Davis * showed nothing pathological in the urine from either kidney *at this time*. Because of the tubercular history and the large kidney with the pain on the right side, a probable diagnosis of renal tuberculosis was made, although special examinations of the urine gave no evidence of it. Six days after entering the hospital the patient had a sudden severe attack of pain on the right side with a temperature of 104° F. and a pulse of 120. The pain persisted and the high temperature was accompanied by chills. The leucocyte count was 10,500. The right kidney was at that time very tender on palpation. Ureteral catheterization then showed that the urine from the right kidney contained pus, blood and swarms of bacilli. There was tenderness in the costo-vertebral angle.

Operation by Dr. Conant on October 31, 10 days after entering the hospital, 16 days after the first attack of pain in the right side, and 3 days after the acute attack, with positive signs in the urine and a markedly tender kidney. Through an incision in the flank the right kidney was removed. A gauze drain was left in. The kidney showed typical foci of infection of various sizes (Fig. 4).

Patient made a good recovery. At no time did the temperature rise above 100° F. The remaining kidney performed its functions with entire satisfaction. The gauze drain was removed on the fifth day. The patient left the hospital on February 27. The wound was healed and she was apparently in excellent general condition.

* I desire to thank Dr. Davis for his kindness in cystoscopy for me a number of the cases.

It is probable that some of the cases, especially those less acute in onset may recover without operation. We can regard this as a reasonable theory in view of the clinical history of a few of the reported cases associated with the appearance of the kidneys at operation.

The number and size of the infarcts and the virulence of the infecting bacteria in relation to the resistance of the individual must determine the healing or activity of the foci. The degree of toxæmia depends also on the same factors. So also it is reasonable to suppose that such attacks may recur and may vary in intensity. Cases III, V and VI in the article bear out this line of thought. Case VI gave a history of recurring attacks of pain of moderate severity covering a period of years with symptoms similar but much less severe than in the last attack, for which I removed the kidney eight days after the onset. The organ showed numerous superficial scars presumably of healed infarcts in addition to many fresh septic infarcts of varying size, one of which contained over a dram of pus (see Fig. 6).

It has been stated earlier in the paper that in the acute cases the course of the disease may be rapid with alarming and increasing toxæmia, or after the acute onset the patient may go for weeks or months in a septic condition while the infarcts become abscesses of various sizes. Do the fulminating and extremely toxic cases, similar to Case I, ever recover from an attack without operation? In the opinion of a few observers they do. It is impossible to say which cases may recover and which may not. In the acute cases operation must be governed by the severity of the toxic symptoms associated with the signs. Delay in operating, especially in those fulminating cases in which diagnosis is doubtful, cannot be justifiable. Delay for reasonable study and observation in the subacute cases will always be wise. The following case is an illustration of the fact that even the most acute cases may recover without operation. This case also illustrates the probability of recurrent attacks where some abnormality in the kidney or ureter favors. In view of the history and the

conditions found at the operation it seems rational to assume that the following case was one of acute infection of the right kidney, although absolute proof is lacking.

CASE III. (*Acute case simulating a grave abdominal emergency. Two operations, the first under a diagnosis of appendicitis.*) Mrs. G. S., 23 years old, married, mulatto, entered the hospital December 22, 1906. With the exception of typhoid fever two years before had always been well. Had had no children. Four days before admission to the hospital began to have pain in the right upper quadrant of the abdomen running through into the back. Pain only moderately severe and not accompanied by vomiting or urinary symptoms.

Examination.—Abdomen slightly tender on the right. No spasm, no mass. Vaginal examination negative. Temperature 99° F. Pulse 110. Twenty-four hours after entrance pain increased in severity. Temperature rose to 103° F. and pulse to 120. Leucocyte count at this time 9000. There was then some general tenderness in the abdomen and slight muscle spasm on the right. Urine examination negative. Next day temperature fell to normal. Operation three days after entrance under a diagnosis of subacute appendicitis. At operation nothing found to account for symptoms. The appendix was removed but showed practically no signs of inflammation. The kidney was not examined. For a week following operation some pain and fever continued. Patient left the hospital apparently well two weeks after the operation.

Two months from the beginning of the first attack the patient reentered the hospital through the accident room. After leaving the hospital she had been well until four days before when she began to have severe pain in the right side of the abdomen and frequent vomiting. She had chills and high fever.

Examination.—She was evidently a very sick woman. The abdomen was generally tender and rigid but the muscle spasm was most marked on the right side. Temperature, 105° F. Pulse, 140, and of poor quality. There was tenderness in the right costo-vertebral angle. White blood count was 25,000. Urine examination found albumin, pus and blood, with granular casts and blood casts. Probable diagnosis of acute kidney made, but a preliminary incision through the right rectus muscle was made

to make the diagnosis certain and settle the presence of another kidney. There was no sign of abdominal infection. The right kidney was felt to be markedly enlarged and the perirenal tissues edematous. There was a slight amount of intraperitoneal fluid between the ascending colon and the enlarged kidney. Cultures from this were sterile. The abdominal wound was rapidly closed, but before this could be done the patient's condition became so serious that no further operation at that time could be considered. She was almost pulseless and required intravenous salt solution and vigorous stimulation on the operating table. She was sent to the ward with the intention of cutting down upon the diseased kidney later if her condition justified it. No second operation was done because of the marked improvement in all the symptoms. The temperature gradually fell and reached normal on the ninth day while the general condition improved. The pus and blood rapidly disappeared from the urine and on December 3 it was normal. The white blood count remained between 18,000 and 27,000 for the first week and then became normal.

Four weeks after operation the patient passed without pain a small calculus about one-sixth of the size of a pea. X-ray photographs thereafter gave no shadow of stone.

I have seen this case at intervals. She has been free from any acute attacks, but complains of more or less constant pain in the right side. Urine examination has showed nothing pathological.

Treatment.—This should always be by operation, even in the presence of severe sepsis. Recovery will be the rule if operation is not delayed too long. In the majority of reported cases nephrectomy has been the operation of choice. In three or four cases drainage of the infarcts with rubber tubes or gauze wicking has been successful. In two of my own cases this method of drainage was chosen; both cases recovered. One remained well but in the other case it was necessary to do a nephrectomy subsequently because of stone (see Case V). In very toxic cases in which the areas of infarction are numerous so that the function of the kidney is seriously interfered with nephrectomy must always be done. In cases where the

infarcts are limited in number and the general condition of the patient is good, the operation of splitting the capsule and draining the infarcts may be considered, but it should be borne in mind that subsequently the patient may have a recurrence of the infection or a renal stone.

The method of operation should be determined upon in each case at the time. Should there be any doubt in regard to the presence and integrity of the other kidney, the simpler operation of incision and drainage should be adopted as a matter of course.

Unless the abdominal cavity has been opened for some reason, either to settle an uncertain diagnosis or through error, the incision should be the usual one in the flank from the twelfth rib to and along the crest of the ileum. The question of whether it is safe, because of the danger of peritoneal infection, to remove the kidney through the anterior incision, has been raised by the operation of Dr. Harrington in Case VII. He is the only surgeon who has had the courage to remove one of these acutely infected kidneys by the transperitoneal route. The method of all other surgeons has been that adopted by me in Case I,—first closing the anterior incision, then taking out the kidney through an incision in the flank because of the fear of septic peritonitis.

The septic foci are directly under the fibrous capsule. The uncertainty as to whether manipulation of the kidney in its removal will break into one or more of the infarcts and the uncertainty also of the stage and virulence of the infection, must decide that there is greater safety in the posterior method; on the other hand, the increased time and added shock of the operation through a second incision are to be taken into account. In my opinion, if the patient's condition justifies the extra time, it is better to remove the kidney through the posterior incision than to take any risk of peritonitis, but in those cases that are too sick for such a prolonged operation, if an anterior incision has been made for any reason, the kidney should be removed through this first incision rather than left *in situ*.

In performing nephrectomy by the transperitoneal method, it is obvious that the greatest care must be taken to prevent infection of the peritoneum by walling off the general cavity with gauze and by the gentlest possible handling of the kidney.

Woolsey has reported a case in which the cortical substance involved only the lower pole of the kidney. He resected the infected third of the kidney leaving the remainder. The infection was staphylococcus. Although this unique operation was successful, it can hardly be a safe procedure, even if the septic areas are so distributed as to make it possible.

All the cases reported in this paper recovered. In the only male case an obstinate colon infection of the bladder has persisted since the nephrectomy. In two cases the operation of splitting the capsule and draining the infarcts was done. In five cases nephrectomy was the operation chosen.

The histories of the five remaining cases will be given as concisely as possible.

CASE IV. (Acute case operated upon 4 days after the first symptoms. Capsule split and septic infarcts drained with gauze wicks. Infection colon bacillus.) Mrs. M. C. D., 45 years old, married, white, entered the hospital through the accident room on the evening of October 15, 1903. She had always been well. She had had three children, the youngest eight years old. Menstruation always regular, the last two months before. Twenty-four hours before coming to the hospital was suddenly taken with severe pain in the right iliac region. Pain ran into the back. The patient noticed at this time that she was obliged to pass water frequently. She had a chill at the onset. The pain persisted in the right iliac region and was somewhat less in severity. The bowels moved well six hours before entrance.

Examination.—Well-developed and nourished woman, evidently in much pain. There was tenderness and muscle spasm on the right side of the abdomen. The right kidney could not be palpated at this time. Nothing abnormal was found in the chest and nothing of importance upon vaginal examination. The blood count showed 22,000 leucocytes. Temperature, 103° F. Pulse, 130. Urine examination showed much pus, blood and an occa-

sional blood cast. Twenty-four hours after admission the right kidney could not be palpated and was found to be tender. The leucocyte count and temperature remained high. Patient appeared to be very sick. Operation on the third day after admission. The right kidney was cut down upon through an incision in the flank. It was found to be enlarged to about twice normal size and on its surface were four areas about half an inch in diameter, dark in color. All of these areas of infarction were soft and seemed to contain old blood clot with some broken down kidney tissue, but in none of them was there any gross appearance of pus; one extended well into the cortical substance of the kidney, the remainder were superficial. The capsule of the kidney was split posteriorly and small gauze wicking drains pushed well down into each softened spot and the ends led out of the external wound. A large cigarette drain was placed down to the kidney itself and the external wound closed in layers.

The operation made no change in the character of the urine until a week before the patient left the hospital, when all pus and blood had disappeared. The amount of urine was between 35 and 40 ounces daily after the operation. Four days after the operation the temperature had dropped to normal and the leucocyte count to 7000. There was an entire cessation of pain. Convalescence was rapid. Patient left the hospital one month after operation with the wound healed and apparently well. Microscopic examination was made of a small bit of tissue from one of the softened areas and showed *marked engorgement of the blood vessels and considerable hemorrhage throughout the cortical substance*. Cultures from the infarcts gave a pure growth of colon bacillus. This patient has been seen from time to time and has remained entirely well.

Were it not for the fact that the onset of the attack was associated with pain radiating into the right lumbar region with frequent micturition and that the urine examination showed blood, pus and blood casts, the symptoms and signs, especially the high leucocyte count and muscle spasm and tenderness on the right side of the abdomen, would have led me to operate soon after the patient was admitted to the hospital under a diagnosis of appendicitis or cholecystitis, but for these reasons operation was deferred for a day or two, at the end of which time a large and tender kidney could be felt.

CASE V. (*Recurrent attacks of pain in the left kidney. First operation 3 weeks after first attack. Kidney decapsulated and infarcts drained. Seven months later same kidney removed.*) Mrs. C. A. H., 44 years old, married, white, entered the hospital December 14, 1907. She had had seven children and two miscarriages. For four years had had recurring attacks of pain in the left side associated with vomiting, frequent micturition and sometimes retention of urine, especially when the pain was most severe. Pain had been general over the abdomen, but also in the back and into the left groin.

I first saw this patient in the Out-Patient Department of the hospital, where a provisional diagnosis of renal calculus was made. Examination at this time found no abdominal tenderness or muscle spasm. Both kidneys could be palpated; the left was larger than the right and tender. Vaginal examination found nothing abnormal. Heart and lungs were normal. X-ray plates gave no evidence of stone. Urine from both kidneys examined separately and nothing abnormal found. After entering the hospital the patient had a marked attack of pain with some rise in temperature. Although the X-ray was negative the symptoms demanded exploration of the kidney and the diagnosis at this time was renal or ureteral calculus. No consideration was given to a diagnosis of septic infarcts.

Operated on May 9, 1907. The left kidney was cut down upon through an incision in the flank. The fatty capsule was adherent. On exposing the kidney it was found to be enlarged with its anterior pole firmly adherent, so that attempts to deliver it were resisted. The surface of the kidney was covered with old scars and also showed a number of areas of infarcts similar to those in Case IV. The capsule was split and the softened areas drained as in the preceding case. The wound was closed around a cigarette drain which was removed four days after the operation. Two weeks after the operation it was necessary to reopen the wound for a collection of pus, after which convalescence was uneventful. On June 28 she left the hospital with a small discharging sinus. This sinus remained open for two months. After its closure she had continued pain over the abdomen, especially on the left side. It was mainly in front, but ran through into the back and was accompanied with frequent and painful

FIG. 6.



Nephrectomy 8 days after onset. Large abscess in central portion, smaller abscesses near the poles. (Specimen from Case VI.)

FIG. 7.



First operation, decapsulation and drainage. Second operation, nephrectomy (7 months later) Stone embedded in one of the calices. (Specimen from Case V.)



micturition. Her general health was good. During the attacks of pain there was nausea and occasional vomiting.

She reentered the hospital for these severe attacks of pain December 14, approximately seven months after the first operation. Examination at this time found some muscle spasm with tenderness on the left side of the abdomen. The kidney could be palpated and deep pressure over it from the front brought on severe attacks of pain simulating renal colic. While under observation for a week the patient had severe attacks typical of renal colic. Leucocytosis, 8000. Ureteral catheterization furnished no positive evidence of stone in the left kidney. At this operation, because of its diseased and scarred appearance and the apparent remains of old infarcts, the left kidney was removed with considerable difficulty. A cigarette drain was left in. Upon splitting the kidney after its removal no stone could be found. To discover a possible stone without cutting it into many pieces an X-ray of the organ was taken which showed the stone plainly. The surface of the kidney was covered with pitted scars of the old infarcts. At the upper pole was a collection of grumous material like a small hemorrhagic cyst just under the capsule. A small stone was found embedded in one of the calices. (The appearance of the kidney and the stone are shown in Fig. 7.)

This case furnishes some evidence that small stones may be the cause of bacterial localization and also suggests that a certain number of these cases may have recurring bacterial infarcts. The recovery from the second operation was uneventful and the patient was seen several months after the operation. She was free from all pain and was in good health.

CASE VI. (Acute case with history suggestive of previous less acute attacks. Operated upon 11 days after the first symptoms. Infection colon bacillus.) Mrs. F. L., 48 years old, married, white, entered the hospital through the accident room on the evening of November 10, 1907. Had had several children. For 16 years had had occasional attacks of pain in the left side of the abdomen and back, somewhat similar to the pain during present acute attack, but not nearly so severe. These attacks had come two or three times a year and during them micturition had occasionally been painful and frequent. There has been no haematuria and she has never passed a stone. Bowels always very constipated. Seven days before admission was taken with sud-

den intense pain in the left side of the abdomen running into the back and left leg, so severe that she had to be etherized by her physician. She had chills and vomited. After acute onset pain persisted but was less severe. At the onset had difficulty in passing urine, but this only lasted a short time.

Examination.—Rather poorly nourished and developed woman, apparently very sick. Tongue coated and dry. Temperature, 100° F. Pulse, 112, and poor. Heart signs weak, no murmurs. Over the left abdomen, especially in the upper quadrant, there was tenderness and muscle spasm. There was tenderness in the costo-vertebral angle and the left kidney could be made out vaguely by palpation, although attempts to do so caused great pain. Vaginal examination found signs of old pelvic inflammation. X-ray plates showed no shadow of stone. Cystoscopy by Dr. Davis showed normal urine from the right kidney, but purulent urine from the left, and on the floor of the bladder was seen a very small calculus. Four days after entrance the left kidney was removed through an incision in the flank. It was enlarged and contained in the central portion an abscess cavity holding two drams of thin greenish pus and in addition small septic infarcts throughout the cortical substance. Cultures from the abscess and from the small infarcts gave pure colon bacillus infection. This patient made a satisfactory recovery and gained weight and strength rapidly after the operation and left the hospital well on December 17, 1907, about five weeks after admission. (This kidney is shown in Fig. 6.)

CASE VII. (Acute fulminating case. Diagnosis of acute appendicitis. Operation 4 days after first symptoms. Infection colon bacillus.) Mrs. M. B., 25 years old, married, white, entered the accident room on the morning of January 9, 1908. She had had a similar attack three months before. Four days previous she was taken with a pain in the right side of the abdomen and vomiting. Symptoms typical of acute appendicitis had persisted. Bowels had moved daily.

Examination.—Evidently very sick patient. Nothing abnormal in the chest. In the right side of the abdomen was tenderness and marked muscle spasm and a mass extending well backward into the flank and down as far as McBurney's point. This mass was tender and resembled an appendix cake. Urine examination showed no blood. No leucocyte count recorded.

Operation by Dr. Harrington three hours after admission. Anterior incision in appendix region. There was no evidence of appendicitis or peritoneal infection. The right kidney was enlarged. This was removed *through the anterior incision*. The abdominal wound was closed in layers, a cigarette drain being left in. The kidney showed numerous typical infarcts. Convalescence in this case was uninterrupted and satisfactory. On January 27, three weeks after the operation, the wound had healed solidly and the patient was discharged from the hospital apparently well with normal urine. (The appearance of the kidney is shown in Fig. 5.) As stated above, this is the only reported case in which nephrectomy was done through the anterior incision.

CASE VIII. (*Subacute case. Operation 3 weeks after first symptoms. Previous operation for stone.*) George H., single, 28 years old, white, entered the hospital December 24, 1907. A large stone had been removed from his right kidney about a year previously. He recovered well from this operation and had no further trouble until three weeks before his reentry, when he began to notice blood in the urine and began to have attacks of pain in the right side and back similar to those he had before his first operation. For a week the urine had been noticeably bloody.

Examination.—Well developed and nourished man. Nothing unusual made out on physical examination except marked tenderness on the right side of the abdomen. There was some muscle spasm, also tenderness over the scar in the flank. The kidney could not be palpated. Urine examination showed albumin, pus and microscopic blood. X-ray examination showed positive shadows of stone. Accordingly Dr. Conant operated for stone on the 26th of December. The kidney was somewhat bound down by old adhesions, but on inspection was found to show typical areas of septic infarcts. After ascertaining the existence of the other kidney by examination across the peritoneum, the diseased kidney was removed and a gauze drain left in. An examination of the kidney after its removal showed no stone. This case recovered satisfactorily with the exception of a persistent colon infection of the bladder, which so far has yielded to no treatment.

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CONTRIBUTION TO RENAL AND URETERAL SURGERY.

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OF CHICAGO, ILL.

I. MULTIPLE URETERAL CALCULI COMPLICATED BY HYPOPLASIA OF OPPOSITE KIDNEY.

THE following case is interesting, from first, the presence of an unusually large calculus in the vesical end of the right ureter, accompanied by a second calculus higher up on the same side which completely occluded this ureter. Second, a hypertrophy and septic condition of the right kidney whose ureter had been obstructed. Third, a hypoplasia of the opposite kidney. We thus have a congenital anomaly in the form of a hypoplasia of the left kidney associated with an acquired pathological condition in the shape of a right septic pyelonephritis in a hypertrophied organ.

The case is particularly instructive because it shows that occasionally, all of the modern methods of exploring the genito-urinary organs, including cystoscopy, catheterization of the ureters, cryoscopic and other determinations of the separately collected urines may fail, be misleading and eventually may cause surgical interference of a contraindicated character.

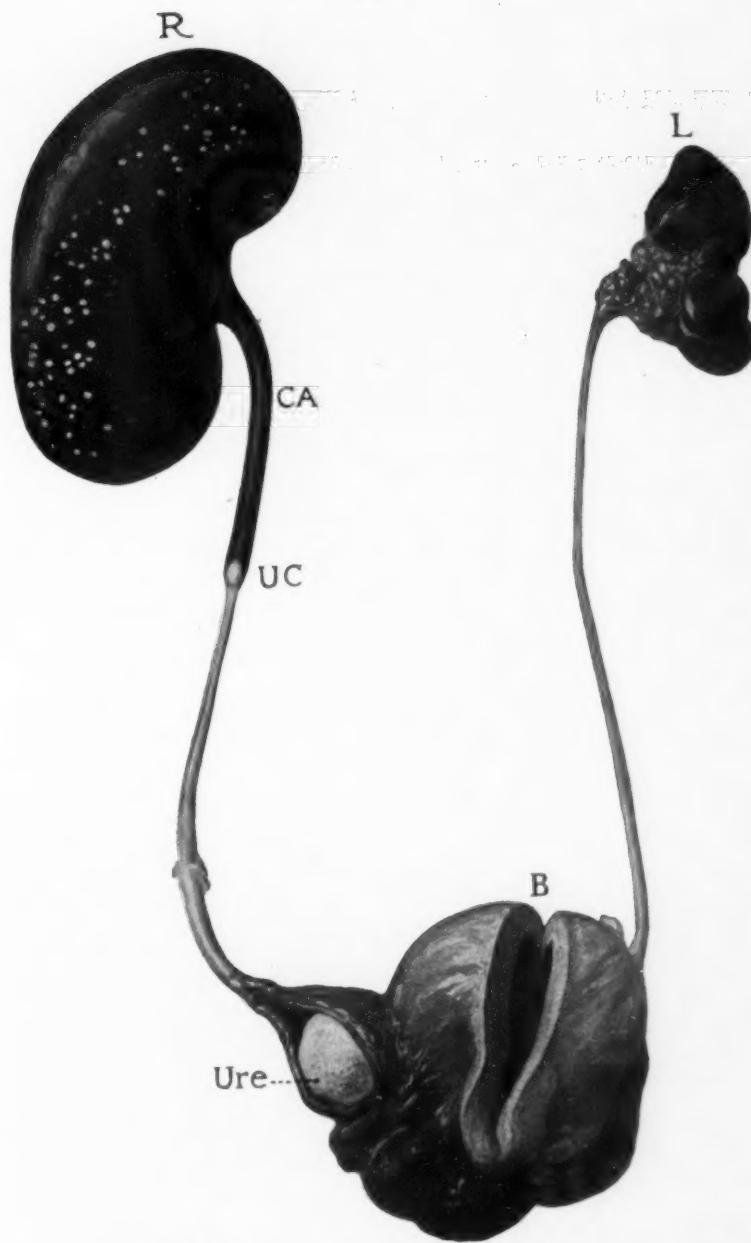
In the case to be reported, that of a man about 35 years old, there was found on post-mortem examination a right septic kidney with calculi weighing 276 gms. One of the calculi was situated in the kidney, one in the upper part of the ureter and one in the latter, just before its entrance into the bladder. It was obvious from the size and the situation of the latter calculus, that it would have prevented successful catheterization of the right ureter. The left kidney while presenting some pathologic changes was found in a condition enabling it

to still secrete a fairly normal urine free from pus, though perhaps containing some casts. But this kidney only weighed 39 gms. after having been preserved in Kaiserling's fluid, and undoubtedly somewhat less when first removed during the autopsy. On an average the adult male possesses about 320 gms. kidney-substance; the left kidney is generally somewhat (6-7 gms.) heavier than the right one. Upon removal of the right diseased kidney, in our case, 39 gms. of left kidney substance would not have been sufficient for the performance of the necessary urinary secretion.

The following is the clinical history of this case:

M. N., aged 34, clerk, was admitted to the Michael Reese Hospital to the service of Dr. Eisendrath on March 11, 1908, with the diagnosis of gall-stones. He had typhoid and pneumonia eight years before admission and had been under the care of a physician for five years for kidney trouble. He was taken sick three days before admission with pain in the right lumbar region and fever. These symptoms were accompanied by a gradually increasing stupor which changed to a coma shortly after admission. His temperature was 103, pulse 160, and respiration 40. The leucocyte count was 7000. Twenty ounces of urine were obtained by catheter during the first 30 hours. This urine contained 1 per cent. urea, a trace of albumin and a few white and red corpuscles, but was otherwise negative. Examination soon after admission showed marked rigidity over the entire abdomen, but most marked over the right upper quadrant. There was apparent tenderness over the area of rigidity, but this was also most marked over the gall-bladder region. This rigidity and tenderness varied greatly in intensity during repeated examinations, so that in the absence of any abdominal distention, of vomiting and the fact that the bowels moved after enemas, it was decided to wait before performing an exploratory laparotomy. During the first 24 hours the following additional symptoms presented themselves: the pulse became more rapid and weaker, rising to 180; he was deeply comatose, rigidity of the neck and arms became marked, a Kernig sign was distinct and there was slight opisthotonus. During the second 24 hours he passed 12 ounces of urine of the same quality as on the previous day. Physical

FIG. 1.



Specimen removed at autopsy showing multiple calculi in right ureter. R. Greatly enlarged right kidney showing evidences of suppurative pyelonephritis. CA. Right ureter distended with blood and urine. UC. Ureteral calculus located just above a stricture of the ureter. Ure. Large faceted ureteral calculus located in distended vesical end of ureter. B. Bladder opened in median line. L. Undeveloped left kidney showing foetal lobulations.



examination showed some dulness and bronchial breathing over the left lower lobe. The diagnosis of severe influenza with meningeal and pulmonary localization was made. The patient became deeply comatose and died on the third day after admission.

Report of Autopsy and Comments.—The brain shows an intense congestion of the entire pia-arachnoid. This membrane is dull, but there is no visible pus. The hemispheres show numerous minute hemorrhages. The ventricles contain an increased amount of fluid and the choroid plexus is congested.

Pericardium and heart, normal except that the left ventricle is somewhat hypertrophic and that the pericardial fat is quite abundant. The beginning of the aorta shows a few small slight elevated atheromatous spots. Coronary vessels normal. The left lung is adherent to the pleura costalis at the lower portion of the lower lobe. This lobe and part of the upper lobe are completely consolidated and pieces taken from these parts sink in water. On section the consolidated areas appear mottled. On the whole the color is dark brown-red, but there are grayish portions here and there. A thick purulent bloody fluid can be squeezed out from the consolidated portions. The right lung is full of air, crepitant throughout presenting in fact a slight degree of compensatory emphysema. In a few places on the dependent surfaces patches of hypostatic congestion are found. Otherwise the right lung is normal.

Spleen considerably enlarged, capsule smooth, dark purplish brown. On section trabeculae distinct; follicles rather indistinct; pulp soft, easily scraped off.

Genito-urinary Organs.—The left kidney is very small, irregularly lobulated, on the whole about the fourth of the bulk of a normal kidney. It weighs after having been preserved in Kaiserling's fluid 39 Gms. On section, this small kidney shows no clear differentiation into cortex and medulla, its pelvis is very small; the left ureter about $\frac{1}{2}$ the diameter of a normal one. Left kidney is surrounded by a mass of hypertrophic perinephritic fat. Right kidney is very large, measuring from pole to pole about 5.5 in. and transversely about the middle of the pelvis over 3 inches. It weighs, after having been preserved in Kaiserling's fluid, 276 Gms. It is dark purplish-pink in color. Capsule smooth and shining; little grayish-white patches from pinhead to millet-sized are seen throughout the capsule. On section the cortex is found to be widened, pyramids injected, renal tissue generally congested, tubules grayish-yellow, dull. Small grayish-white areas are found dispersed throughout the renal tissue. Near the upper pole at the junction of the medulla and the cortex a stone of the size of a cherry-stone is found lying free in a smooth-walled cavity. The pelvis of the right kidney is large and the first portion of the ureter is conically enlarged so that at its exit from the pelvis the base of the cone has two to three times the diameter of a normal ureter. About 3 to 4

inches downward a conical-shaped stone is wedged tolerably firmly in the ureter, obliterating it completely. Just below the point where this stone is situated, the ureter is somewhat constricted, lower down it is uniformly enlarged again, until it reaches the bladder. Before entering the bladder, the ureter forms an ampulla which contains a whitish, rather soft stone, the size of a large walnut. The bladder itself is rather large its walls markedly hypertrophied. Mucosa congested. Prostate normal. *Liver* slightly congested, otherwise normal; gall-bladder contains about 50 to 60 cc. of dark-green bile; no stones. Stomach and intestines negative.

Anatomical Diagnosis.—Acute congestion of pia-arachnoid. Adhesions at base of dura mater. Consolidation (red hepatization) of the left lung; congenital hypoplasia of the left kidney; multiple metastatic bacterial emboli of the right kidney; calculi in the right kidney and right ureter. Chronic cystitis. General septico pyæmia.

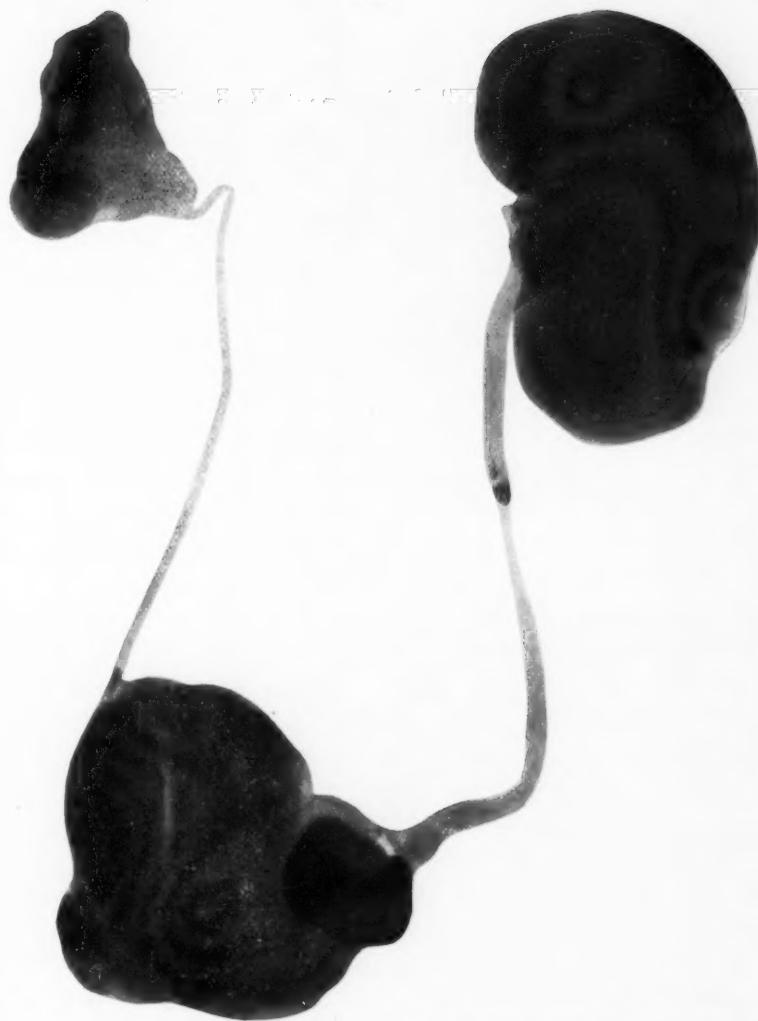
Chemical and microscopic examination of the large soft stone in the lower portion of the ureter shows that it is mostly composed of triple phosphate of calcium. Cultures made at the postmortem examination of the heart's blood and from the consolidated areas of the lung developed cocci and a small bacillus, the latter, however, not the bacillus of influenza.

Histological Examination.—Smears from the consolidated portion of the lung show desquamated alveolar epithelia, mono- and polynuclear leucocytes, erythrocytes, cocci and small bacilli.

Sections of the consolidated portions of the alveoli are filled with a cellular exudate composed of red and white blood-corpuses and desquamated alveolar epithelia. The erythrocytes generally predominate. However, there are also some alveoli where the white corpuscles are much more numerous than the red ones. The inflammatory exudate in the alveoli contain many cocci, small and also large slender bacilli. The cocci are not of the type of the pneumococcus, but are staphylococci. In the interior of some of the red blood-corpuses chromatophilic bodies are seen. Throughout the tissue of the *right kidney* are seen numerous foci with dense leucocytic infiltration and quite a few uriniferous tubules contain a purulent exudate. Coccoi and bacilli are found both in the interstitial inflammatory foci as well as in the purulent material in the uriniferous tubules.

The small left kidney microscopically shows a differentiation into a cortex and a medulla which had not been distinctly visible on naked eye inspection. In the cortex are seen numerous glomeruli; some of them exhibit very marked thickening of the capsules of Bowman with beginning atrophy of the Malpighian tufts. Most of the glomeruli however are in a normal condition. Chronic interstitial changes are also seen in the medulla; here in some places the interstitial connective tissue between the tubules is markedly increased. On the whole, however, the interstitial changes are not very extensive. In other places both in the cortex and medulla small foci of mononuclear cells are observed, among the latter are likewise found quite a number of polynuclear eosino-

FIG. 2.



Skiagraph obtained by placing specimen shown in Fig. 1 upon an X-ray plate. The location of the ureteral calculus is well shown and the calculus located at the middle of the ureter is conical, its pointed end projecting into the stricture. Several calculi are seen in the parenchyma of the right kidney. The faceted nature of the lower ureteral calculus is well shown.



philes. The vessels of the small left kidney are generally congested. The epithelia lining the uriniferous tubules are generally fairly normal, while some show cloudy swelling. Hyaline casts are found here and there in the tubules. Bacteria could not be found in the sections of the left kidney, so it appears that it does not contain any bacterial foci which are so numerous in the large right kidney. Sections through the pia-arachnoid and the brain-tissue which show highly congested vessels likewise do not exhibit any bacterial invasion.

REMARKS.

1. It is rather unusual to have as large a ureteral calculus situated at the vesical end of the ureter as this case shows. The calculus was in reality double, the two being faceted.

2. The upper of the two ureteral calculi completely occludes the right ureter so that it is difficult to say whether the symptoms of this patient were due to calculous anuria or to the septic condition resulting from suppurative pyelonephritis, or, finally, whether the entire clinical picture was not due to a severe influenzal infection.

The presence of pneumonia and of the condition of the meninges rather speak for some general infection. From a surgical standpoint the case is especially interesting. The X-ray prior to any operation upon this patient would, of course, have shown two calculi. The case shows above all, the great necessity of making a careful determination of the functional capacity of the kidney before performing a nephrectomy.

2. RENAL LIPOMA, "*ex vacuo*."

Lipoma of the kidney is quite rare and the renal tumors described as such are really to be divided into two separate groups, entirely different as to their etiology.

True lipomata of the kidney according to Borst (Die Lehre von den Geschwulsten i, 141) are generally small, multiple, sharply defined, and situated subcapsularly or in the peripheral parts of the cortex, rarely in the medulla. They probably take their origin from misplaced embryonal inclusion derived from and cut off from the perirenal fatty tissue. Frequently these renal lipomata are found symmetrically in both kidneys. In consequence of atrophy of the renal tissue we

encounter fatty tumors due to a considerable increase either of the fatty tissue at the hilus or of the perirenal adipose tissue. These hypertrophic lipomatous masses have been called, "lipome intranephritic" and "lipome perinephritic" by the French writers, and "kapsulære Lipome" by the Germans.

In some cases of this kind there is found in place of the kidney a lump of fat, having the shape of the kidney and still containing small remnants of kidney-tissue. The hypertrophy of the adipose tissue generally arises from a pelvis containing renal stones. Borst gives it as his opinion that in all cases of hypertrophy of the hilus and perirenal fat the atrophy of the kidney-substance is the primary factor and it is not the proliferation of the adipose tissue which secondarily leads to pressure atrophy of renal tissue.

The following is a case representing a lipoma of the second group, namely one which was due to hypertrophy of the adipose tissue; the hypertrophy following atrophy of the kidney-substance in consequence of stones and inflammatory processes of long standing. The clinical history of this case is as follows:

The patient was 28 years of age, a conductor by occupation, and admitted in October, 1906, to the service of Dr. Eisendrath, in Cook County Hospital. The patient had been operated upon 11 years before admission on account of perinephritic abscess, since which time a sinus had persisted over the left renal region. This sinus was located in the left postaxillary line about midway between the left last rib and the crest of the ilium. It was impossible to pass a sound further in than about 3 inches. Prior to the operation a ureteral catheterization was performed by Dr. Louis E. Schmidt, who found that urine which was entirely normal in character escaped from the right ureteral catheter, whereas it was impossible to pass a catheter for about one inch above the vesical end of the left ureter. An incision was made on the left parallel to the last rib and the kidney region explored. There were a number of dense adhesions around what seemed to be the kidney, but it was impossible to detect any kidney-substance proper. After extensive manipulation, it was possible to free

FIG. 3.

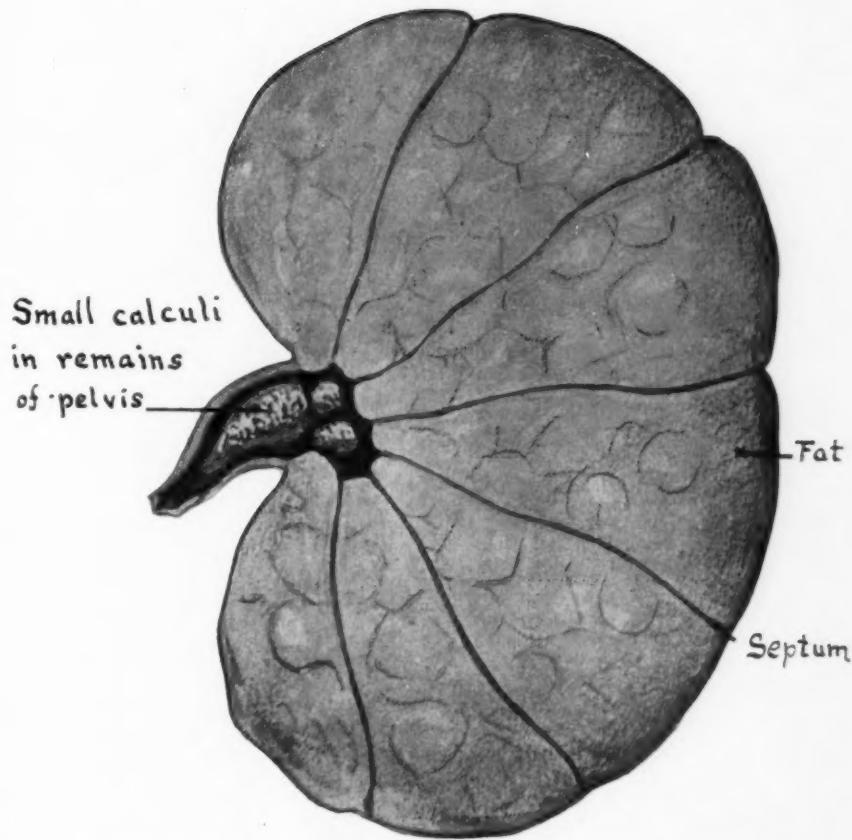
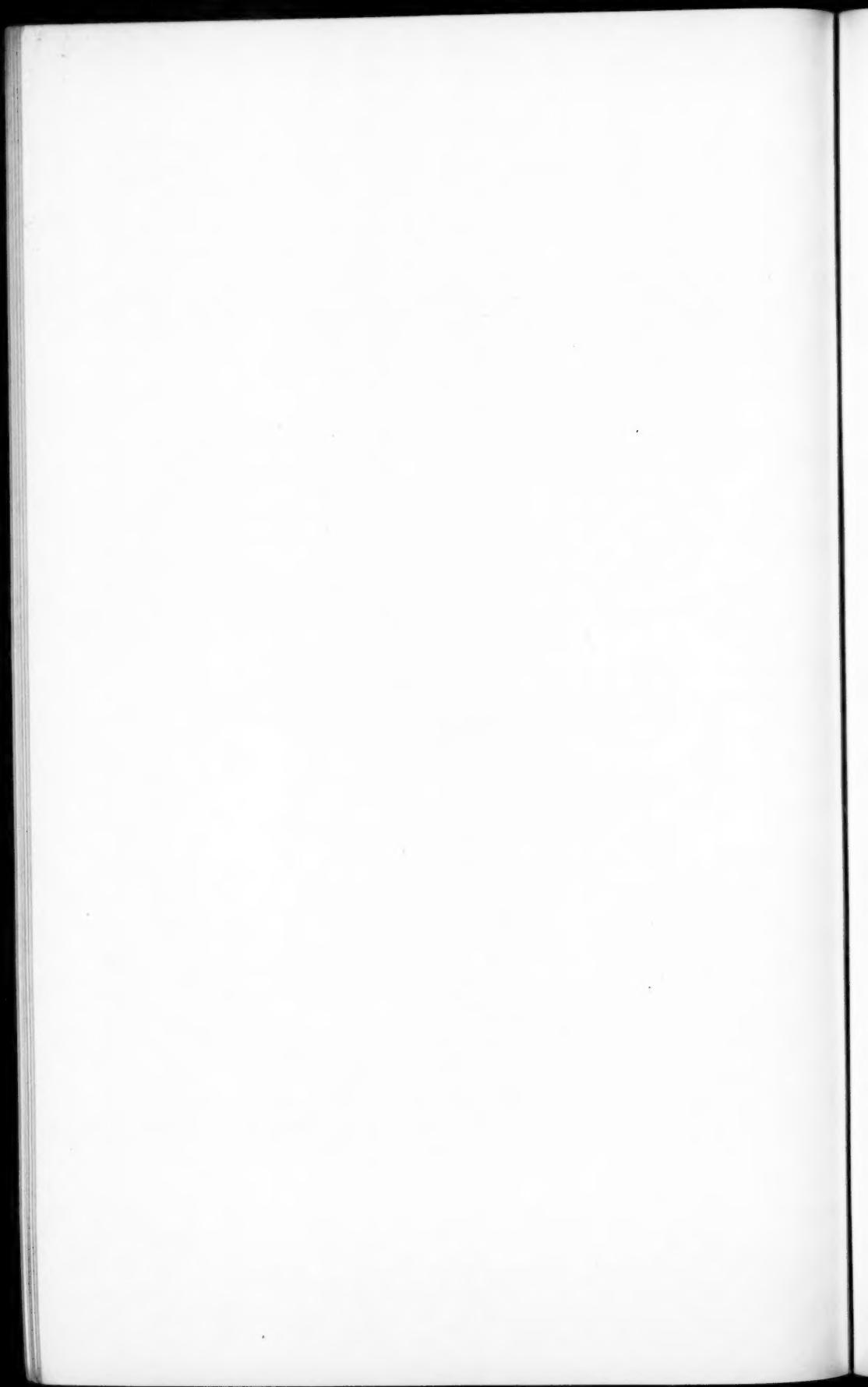


Illustration showing fatty transformation of kidney as a result of chronic suppuration following calculous pyelitis, etc.



what seemed to be a mass of fat, which had the shape of the kidney (Fig. 3), but was somewhat smaller than an adult fist. Further examination showed that this mass had the shape of the normal kidney and was located in the position of the latter. In the freed specimen it was possible to identify several septa between the lobules of fat which corresponded to the septa between the original lobules of the kidney. The sinus itself led through this mass of fat into a dilatation which corresponded to the pelvis of the kidney and contained several small calculi. It was not necessary to ligate any vessels of the pedicle.

Microscopic examination of the mass removed showed it to be composed of loose areolar connective tissue, the meshes being filled with fat. The septa noticeable on naked-eye inspection were composed of coarse, more or less hyaline connective-tissue fibres. No remnants of any kidney-substance could be found in any of the sections examined. Apparently the renal tissue had disappeared and had in the course of time been completely displaced by the lipomatous mass.

We are dealing in this case with the type called "lipome intranephritic" by the French writers, because the renal septa still present demonstrate that the lipomatous mass proliferated right inside of the disappearing kidney-substance. It was also impossible to demonstrate any kidney-substance left. In perinephritic lipoma (as seen in such a case by one of us) there is generally a small mass of atrophic renal substance left which is placed like a small cap on the upper pole of the lipoma.

3. RUPTURE OF THE KIDNEY (Fig. 4).

The following is an unusual case of rupture of the kidney, with subsequent infection and destruction of most of the mass of the injured kidney. A small remnant remaining continued to secrete a urinary fluid. This fact, however, is not at all surprising since we know quite well that parenchymatous organs even if their environments are changed or if transplanted keep on furnishing their normal secretions or excretions as long as they have a sufficient blood-supply and an adequate outlet for the products of their physiologic activity.

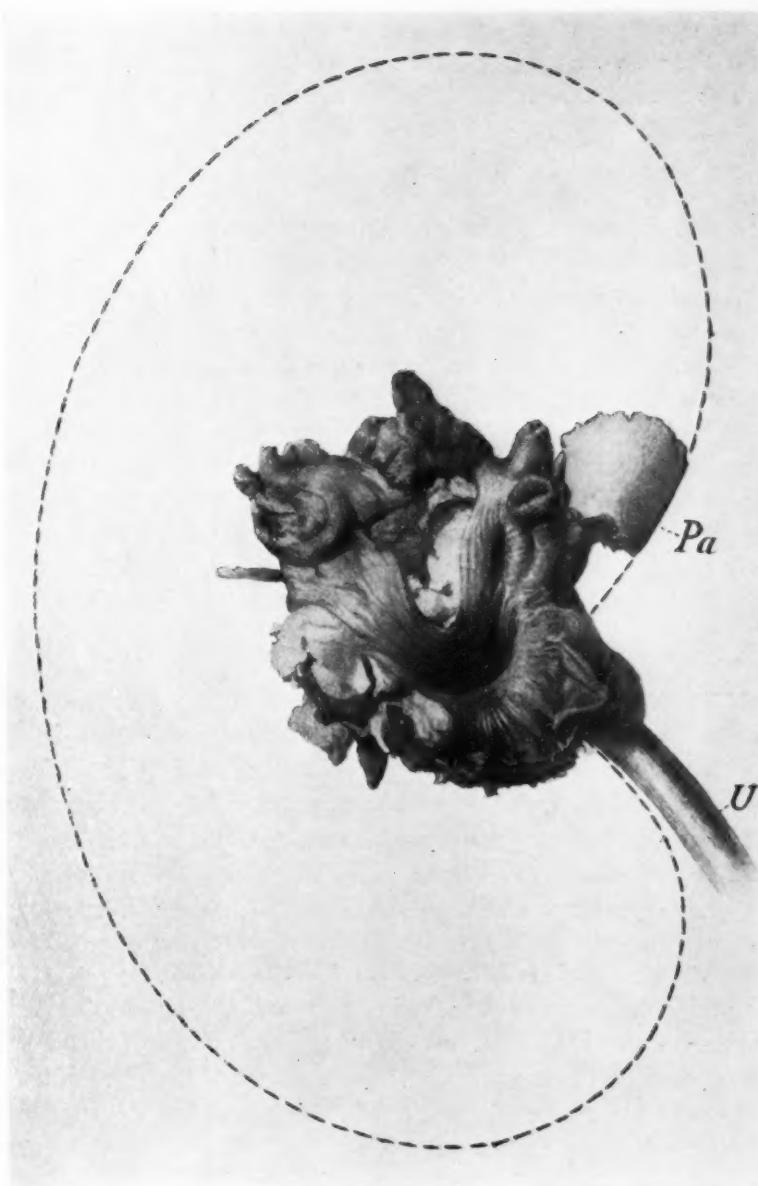
The clinical history of the case referred to is as follows:

The patient was admitted to the service of another surgeon in the Cook County Hospital, January, 1906. He had been on a protracted spree and could give no history of the manner in which he received his injuries. He complained of pain in the right side of the abdomen and there was tenderness on pressure in the right hypochondriac region. The urine contained a large amount of blood. There were no external signs of injury, but the patient was suffering considerable shock. On January 8 patient seemed to be in more pain than during previous days. There was a moderate amount of tympany and haematuria continued to quite a marked degree.

On January 9 an exploratory operation was performed and the kidney exposed. A moderate amount of urinary infiltration was found around the kidney and a drain was inserted down to the pelvis of the kidney. Blood persisted in large quantities in the urine for a number of days after this operation. He was admitted to the service of Dr. Eisendrath May 10, 1906, on account of a urinary fistula situated about one inch below the last left rib in the midaxillary line at the centre of the former nephrotomy incision. A bloody watery fluid escaped mixed with pus. A probe was passed into the fistula downwards and inwards for about four inches. The former incision was reopened under anaesthesia and the finger at once entered a cavity containing about eight ounces of turbid fluid evidently urine. Finger upon being inserted into this cavity entered at once a structure which was readily recognized by those who examined him as the hilus of the kidney with the area extending downwards and inwards from it. Examination of the cavity showed that there was a portion of the kidney-tissue left along its anterior surface about the size of a walnut.

The kidney itself had probably been destroyed by the original injury or disintegrated by the subsequent infection. There was left in addition to this small fragment of parenchyma only the pelvis and the area extending from it. (Fig. 4.) A sinus persisted for some months so that on July 20 it was necessary to reopen the wound and remove several small fragments of renal parenchyma which were adherent to the edge of the cavity and had evidently continued secreting. After this last operation patient made an uneventful recovery and wound healed.

FIG. 4.



Specimen from a case of complete rupture of the kidney. Pa. Remains of parenchyma.
U. Ureter with remnants of pelvis and chalices attached.

ARTHOPLASTY FOR COMPLETE ANKYLOSIS OF THE ELBOW.

RESULT ONE YEAR AND A HALF AFTER OPERATION.

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JANUARY 24, 1906. An adult male fell and sustained a T-fracture of the left elbow-joint, the internal condyle being displaced upward and forward. When I saw this patient March 3, 1907, there was complete ankylosis of the elbow to flexion and extension. The elbow was ankylosed at about 125° in extension. Supination was normal but pronation was considerably limited. The accompanying X-ray photographs show well the lesion at the lower end of the humerus and the ankylosed condition of the joint at this time. (See Fig. 1.)

It seemed wise to do an arthroplasty rather than an excision of the elbow for the reason that the latter often leaves the arm without the power of forcible extension. Consequently a transverse section of the olecranon was made [Trendelenberg] to secure access to the old but obliterated joint surfaces. A chisel separated the bony surfaces. Sufficient bone was removed from the humerus and olecranon to fashion a fairly naturally shaped elbow-joint.

It was demonstrated, before considering the new joint well-fashioned, that normal motion existed in complete extension and flexion, with absolutely no impediment to a complete excursion. Every vestige of synovial membrane was removed. The new joint bony surfaces having been completed, a rectangular fascial fat flap (Murphy) was taken from the fascia overlying the triceps, far up the back of the upper arm. This flap was transferred to the space between the bones forming the new elbow-joint. The flap was pedicled just above the elbow-joint on the back of the upper arm. The free margins of the flap were loosely caught to the peri-articular tissues to prevent dislodgement. All bony

surfaces entering the new elbow-joint were completely covered by the flap. Plain No. 1 catgut sutures were used. The divided olecranon was sutured with aluminum bronze wire. The soft parts were closed tightly about the joint in two layers.

A removable internal angular splint was worn for some six weeks. Limited passive motion was begun less than two weeks following the operation. Very limited active and passive movements were encouraged after the second week, always avoiding pain to the joint which did not subside after a few moments' rest.

The active motion after a year and a half is seen in the figures. The joint is strong, it is most serviceable. When the joint is not actively engaged there is a distinct laxity of it. It is a loose joint—not a flail-joint—but it is a little loose. The moment the muscles contract the joint is as firm and secure as a normal joint. The power of extension is preserved. The patient is able to play golf well.

REMARKS.

In those cases of ankylosis of the elbow-joint in which a diseased process has subsided (tuberculosis, gonorrhæal arthritis, the arthritides from other chemic or bacterial causes) and in those in which an old fracture of the elbow existed, arthroplasty will often secure a more useful joint than excision.

Ankylosis of the elbow in youth below the age of union of the epiphysis to the diaphysis should not be treated by operation. After the full growth of the individual is reached then operation may be done without fear of impairing growth.

Arthroplasty is indicated in those cases of joint ankylosis in young adults in which motion with power is desired.

Lexer in a recent paper before the American Surgical Association upon "Substitution of whole or half joints from freshly amputated extremities by free plastic operation" objects to arthroplasty because of a fear of subsequent ankylosis. This objection in my experience with the elbow-joint does not hold if sufficient bone is taken away so as to secure a freely movable joint before the plastic is done.

FIG. 1.



Fracture of internal condyle of humerus with a transverse fracture of the shaft of the humerus. Taken one month after the accident. Note the displaced fragment. (X-ray by Cole.)

FIG. 2.



One month after operation. Note none of the radial head removed, wire in olecranon, displaced and attached internal condyle utilized as a new condyle. (X-ray by Brown.)

FIG. 3.



Voluntary extension one year and a half after operation of arthroplasty.

FIG. 4.



Voluntary flexion one year and a half after operation.

I have had one case in which, because of attempting to preserve too nice and accurate a bony joint, a partial ankylosis followed an arthroplasty.

The flail-joint of an ordinary excision is to be avoided. A stable joint with power in extension is desirable. Power in flexion is naturally present. An arthroplasty preserves power in extension.

Arthroplasty is especially applicable to the elbow-joint—less so I think to the knee and hip.

SOME SURGICAL CONDITIONS IN THE KNEE-JOINT.

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Harvard Medical School.

AT the 1906 meeting of the American Medical Association some speakers whose enthusiasm and success in other operative lines is above question, expressed themselves as against operative repair of patellar fractures and this probably describes their attitude towards all knee-joint operations of choice. While this hesitation must be the result of their own observation, it does not seem to the writer to be justified by the best results obtainable.

There are three possible dangers in knee-joint operating—to life, to limb and to function.

The danger to life is small. In my paper in the *ANNALS OF SURGERY* for July, 1904, I found 297 recorded personal operations in the previous nine years on clean knees without a death. From the combined reports of the Massachusetts General and the Boston City Hospital covering the ten years preceding 1907 I find that 487 presumably clean knee-joints were opened with three deaths from sepsis, one from cerebral hemorrhage, and one from delirium tremens. There is a death-risk in all surgery, but since the complete section of all ligaments and exposure of the entire joint-surface has been practiced in septic conditions, I think the mortality will run lower than for the simpler aseptic abdominal operations. There should be practically no mortality.

The risk to limb has also been nearly eliminated by the operation referred to above. Amputations are reported less and less, and if the complete drainage-operation be done early enough an amputation should never be required. No amputations were performed in my previous list of operations. I have found one recorded since that list was made up.

The possibility of more or less loss of function remains to be considered. Permanent disability after operation on a clean joint almost without exception indicates adhesions within the joint. If adhesions could be prevented we should always get good functional joints, provided our diagnosis and treatment were correct.

I have dissected three joints showing fibrous ankylosis—one tubercular and the other two old cases probably not tubercular, but infection unknown. There was no adhesion of articular cartilage to articular cartilage in any of them, there was adhesion of a semilunar to the femur over an area of a half centimetre in diameter in one of them, and in every possible place there was adhesion of synovial membrane to synovial membrane in all of them. This suggests that in the knee-joint we can compare the adhesion problem with the same problem which has been much more studied in abdominal conditions in spite of the fact that there are both chemical and mechanical differences between the great synovial and the greater serous cavity.

The abdominal cavity is lined with serous membrane which is provided with stomata against constantly moving muscles which act as natural drainage pumps. Some parts of the walls and probably of the abdominal contents are always in motion, in spite of which we may find pus confined to a very small area. In the abdomen there are innumerable thin-walled blood-vessels which can play their osmotic part in the removal of fluid.

The knee-joint is lined with synovial membrane which secretes a thick lubricating fluid. No suction apparatus independent of ordinary joint-motion has been demonstrated, and there is no extensive system of thin-walled blood-vessels. Moreover an infection confined to one part of the cavity does not seem possible.

Clinical experience shows that the two cavities react to trauma and to some infections quite differently. We never see the abdomen fill up with serum as a result of a contusion

or aseptic laparotomy, while we have all seen knee-joints distended from similar causes.

Outside of miliary tuberculosis, portal obstruction, chylous ascites, certain cancers, and conditions producing general dropsy we know of no cause which will keep the abdomen distended with fluid for weeks, but blood has been found in a knee ninety-eight days after injury and gonorrhœal infection may keep a knee more or less distended for months. Under some conditions this may be an advantage. Suppose a case like those mentioned in the part on "Pads." After a tab is caught and partially crushed, the synovial fluid is poured out freely, the capsule is stretched and the tab is pulled out from between the bones.

It is not at all uncommon for patients to say that their knee works better when it is swelled, but such knees are continually getting into trouble until the surgeon or rarely some extra violence removes the offending tab and then the trouble is over. In any case the "water on the knee" which is often blood—the "chronic synovitis" the "subacute rheumatism" or whatever it may be called is almost always a symptom of some mechanical damage within the joint, and demands a real and accurate diagnosis by which only can we apply rational and appropriate treatment.

If we accept the conclusion that the natural drainage of the knee is so much inferior to that of the abdomen particularly when we follow the conventional treatment and immobilize the joint, it seems possible that we can improve results in aseptic knee-joint operations by providing for escape of the excess of joint-fluid for a few hours and by allowing as much motion as safety from bleeding and security of the sutures will permit. In septic conditions there is no longer any argument as to the desirability of opening, washing and draining freely, but I believe we should go further. There is never perfect rest in the abdomen. Walls or contents are always in motion so long as breathing lasts. Why then should we strive for perfect immobility and continuous contact of inflamed surfaces in

septic conditions of the knee unless we are deliberately trying to get ankylosis?

I believe that there will be fewer cases of ankylosis after operation on septic knees when we learn and insist on the proper amount of movement during the drainage and convalescent stage.

My preference is to use nothing stiffer than a hair pillow splint after operation and trust to the slight involuntary movements of the patient for preventing adhesions. If a splint be used the surgeon can break up the soft adhesions in twenty-four hours and every day thereafter by ten or fifteen degrees of passive motion.

Sepsis after operation will almost always leave some limitation of motion, but if knee-joint sepsis is not too severe to recover through incision and drainage we ought to begin motion early enough and persist until we have gained all possible for the patient. Drainage should be kept up until pure yellow synovia appears and motion should be started before the drain is removed, if as usual the joint is immobilized. Such limitation of motion as comes from infiltration and stiffness of the fibrous capsule can be taken care of later but adhesions gain strength the longer they are undisturbed.

The most essential element in avoiding infection is of course asepsis. Sterile gloves, instruments, sutures and dry-goods are demanded and provided for almost all operative work, but a sterile operative field is even more important in knee-joint work than in other locations where nature can take care of a certain amount of infectious material.

We can open an abdomen in an emergency with no more preparation of the skin than is possible on the operating table and with confidence in the result so far as the incision is concerned, but the knee is a different proposition. The skin over the knee is smooth in complete flexion, but is folded into fine wrinkles in extension, and the razor and scrubbing brush cannot remove the surface epithelium so well if preparation be done with extended knee as they can on a smooth abdominal wall or a flexed knee.

On most persons the skin over the knee is more exposed to dirt, cleanses itself less by perspiration, and receives less scrubbing with soap and water than the skin over the abdomen.

With these facts in mind I shave and scrub my knee-joints while flexed and then allow three days of antiseptic wet dressings before the final soap and alcohol preparation on the table. On my last three knees I have used an exceedingly weak solution of chlorinated soda—so weak as to cause no smarting and to give a barely perceptible odor of chlorine, with entire satisfaction.

FRACTURE OF THE PATELLA.

After fracture of the patella there must be blood in the joint. Blood in the knee is always slow to disappear and with prolonged immobility may help to form undesirable adhesions. This blood can all be removed at operation. The desirability of removing bony fragments so that they may not interfere with joint-action later needs no argument.

Studies on the healing of abdominal wounds where there is accurate coaptation of tendon to tendon but where immobilization is impossible and where there must have been intermittent traction across the suture line, show dense new connective tissue at the end of two weeks.

Surely the tendon of the quadriceps kept still will be no slower in healing and passive motion ought to be safe and desirable much sooner with accurate coaptation of the torn edges of the tendon than in a case where the intervening space must be bridged across through blood-clot by the fibrillæ growing from the severed ends. This means absence of permanent adhesions, for adhesions gain in strength as does the sutured tendon, and a patient will easily endure their rupture at the end of a day or two, when he would require an anæsthetic, bleed more, and very likely reproduce them because of the pain on voluntary motion at the end of four or six weeks.

Tension on the sutures is very slight unless the fracture be old and fragments widely separated, but if a knee is sewed up without drainage there may be tension from an excess of synovia poured out after the washing and the secondary

FIG. 1.



Five months after fracture and suture of patella, with chromic catgut.

trauma. In some cases this will produce the same sort of pull on the sutures that distention of the intestines produces after a laparotomy. It is only necessary to leave in a twisted silk-worm gut drain for a few days to avoid this, which is a real discomfort to the patient and a slight risk to the sutures. No infection from a properly prepared skin and dressing will travel up against the constant outflow of the first three days.

Absorbable sutures seem to be used almost universally now and to my mind they are the only ones to be considered. The ultimate strength of the tendon depends on its reproducing its own tissues and any suture-material remaining at the end of four or six weeks is only a foreign body—useless if not a nuisance.

The complete restoration of the patella is of less importance than careful coaptation and suture of the aponeurosis on either side and any fragment of bone which cannot be held in place by sewing through its periosteum may as well be removed. It may do harm by furnishing a rough posterior surface to the patella while its absence is of no great consequence.

From the same sources before referred to I have collected the cases of fractured patella from 1897 on. There have been 378 cases of which thirteen were compound. Of these 195 were wired or sutured with five deaths of which three were operative. There were two deaths among the cases not operated. It is interesting to note that in 1897 16 per cent. were sutured in some fashion and in 1906, 60 per cent. Apparently all patellae operated were wired previous to 1899, and in 1906 there were more than three sutured to one wired.

The accompanying X-ray (Fig. 1) taken five months after suture of aponeurosis and patella with chromicized catgut, the patellar sutures being passed mattress fashion through the aponeurosis over the patella, shows conclusively that neither drill, wire nor silk are needed for a perfect result. The patient, G. L. G., 26, female, ruptured her left patella and aponeurosis February 21, 1906. Five days later, after three days of preparation at her home and assisted by her

physician, Dr. J. H. Costello, the joint was opened, clots washed out, and the suturing was completed as above-described with silkworm gut drainage. Three days later the joint was moved for the first time, in six days a light plaster was applied and the patient got out of bed. Her recovery was uneventful in every way.

INFRA- AND SUPRAPATELLAR PADS.

There are certainly two types of patients who present themselves with disability due to hypertrophy of these structures. The most common type in my experience is usually a woman and almost always fat. Almost every physician recalls the dissecting-room subject with the thick layer of subcutaneous fat, fat about the nerve and vessel trunks, fat between and within the muscles, and fat even within the bones themselves. In the knee-joints of such specimens are found exceedingly well-developed fat-pads both above and below the patella and almost invariably their edges will show a degree of fringing which indicates mechanical damage. Many patients with such structures come to us complaining of sore knees and disability particularly on stairs. They suffer from a vicious circle of their own—they are fat and walking is uncomfortable, therefore they do not walk and therefore they become more fat and walking is increasingly difficult. They are not patients who easily consent to operation nor are they always desirable risks.

In my hands baking has given no permanent and little temporary relief to such patients. Massage has been a little more useful. Bandages and elastic knee-caps have restricted the movements of the joint and thereby diminished the passive pain and some of the pain on motion for a time.

These tabs may be found as I have before stated, connected with the suprapatellar fat-pad and catching between patella and femur or connected with the infrapatellar pad and catching between femur and patella or femur and tibia according to their attachment to the upper or posterior part of the pad. As a temporary relief to these patients I have found firm pressure by adhesive straps to be sometimes useful.

FIG. 2.

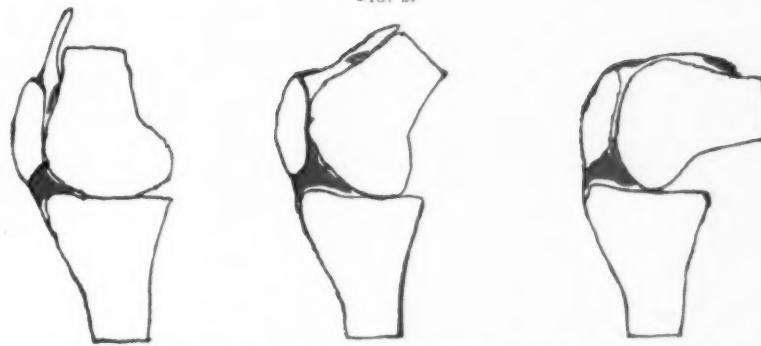


Diagram showing the relation of the supra- and infrapatellar pads to the bones in different positions.



If the offending tab be catching between patella and femur the pressure should come below the patella. If the tab catch between the femur and tibia the straps to give any relief should be applied so as to compress the capsule above the patella, but relief is less certain with tabs in this location.

If the patient can be made to lose flesh either by diet or by thyroid feeding the symptoms will sometimes disappear probably because the intra-articular masses shrink as fat is absorbed from the rest of the body.

An example of this type of patient was T. P. A., 39 years old, seen in 1904. In ten years of married life her weight had increased fifty pounds. Formerly athletic, she had given up all out-door sports, and complained bitterly of the pain caused by active extension of both knees. In extension the infrapatellar pad caused a decided prominence on either side of the patellar tendon and was tender to external pressure. There was no history of any injury to or snapping within the joint, but with slow passive extension pain could be produced and the characteristic crushing sensation felt. Under thyroid feeding, she lost sixteen pounds in four months and the disability in her knees at the same time. She has kept her weight down and now plays tennis and goes up and down stairs with comfort. The external tenderness is seldom present, though there is more than normal prominence over the infrapatellar pad. Some day she may require operation, but so far she has done very well without it.

The other type of patient is often young, in good physical condition and frequently athletic. I do not know how early these tabs may begin to cause trouble, though I have seen them from twelve years on. In such individuals I think any temporizing measures a waste of time if the patient will consent to operation. The tab is probably fibrous and growing more solid with every healing after being hurt. There is increasing possibility of its throwing its owner down in some unpleasant situation, and the recurring periods of disability mean much compared with the few days of convalescence from the slight operation required for removal. To show the sim-

plicity of the diagnosis and operation I have selected two cases:

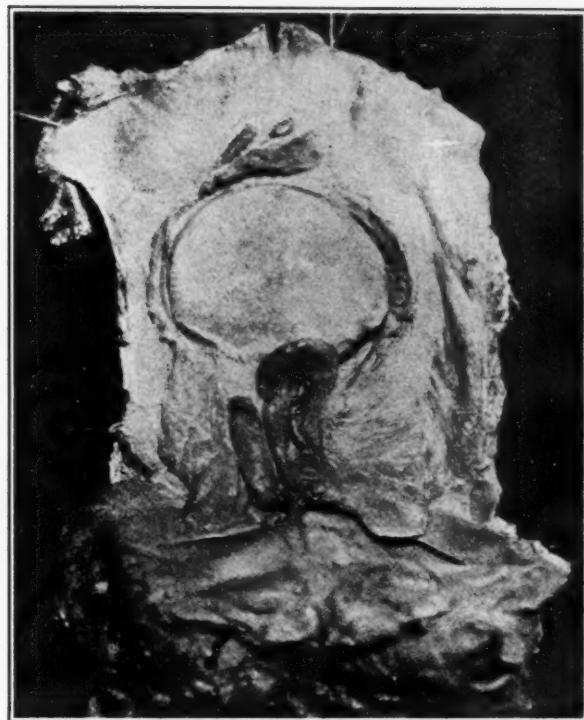
The first, H. C. W., 22, male, student. He was an athlete preferring long-distance runs. He was seen in February, 1906, in Dr. A. M. Cleghorn's office with a swollen and painful knee which had annoyed him twice before after a long walk. He was conscious of something catching at times, more often when going down stairs, and passive flexion with pressure on pad and patella produced a characteristic slight snap.

His joint was opened at the Stillman Infirmary February 11, and a thick, slightly-fringed pad was removed from the upper part of the infrapatellar pad. The incision was closed except for a silkworm gut bundle at the lower end of the wound, which was removed in five days, when his knee was first moved. His splint was removed on the tenth day, he left the hospital on the seventeenth day, and walked into my office with a cane on the twenty-third day with very little enlargement of the operated side, and approximately 120 degrees of flexion. During the summer of 1906 he rode a trotting horse, swam, played tennis, danced and walked without any discomfort in the knee. This tab was removed before the rest of the joint had become in any way damaged, and there is no reason to think that this knee will give him any further trouble.

Another case is Mrs. D. B. R., who had been on crutches most of the time for fifteen months, and had tried every palliative thing that could be suggested even to the actual cautery on the skin over the pad. Tabs were present in both knees. One knee was operated December 6 and the other December 18, 1907, at the Boothby Hospital. Both joints were drained, no splint except hair pillow was used, and she went home on Christmas day. She gave up crutches within ten days and began to travel over the stairs. In February she went skating, and was free of all discomfort though her muscles had not fully recovered from their long disuse.

Figs. 3 and 4 reproduced from my previous article show two varieties of these disabling structures. The one shown in Fig. 3 will produce a snap as it slips from between patella and femur, while the one in Fig. 4 will give the crushing sensa-

FIG. 3.



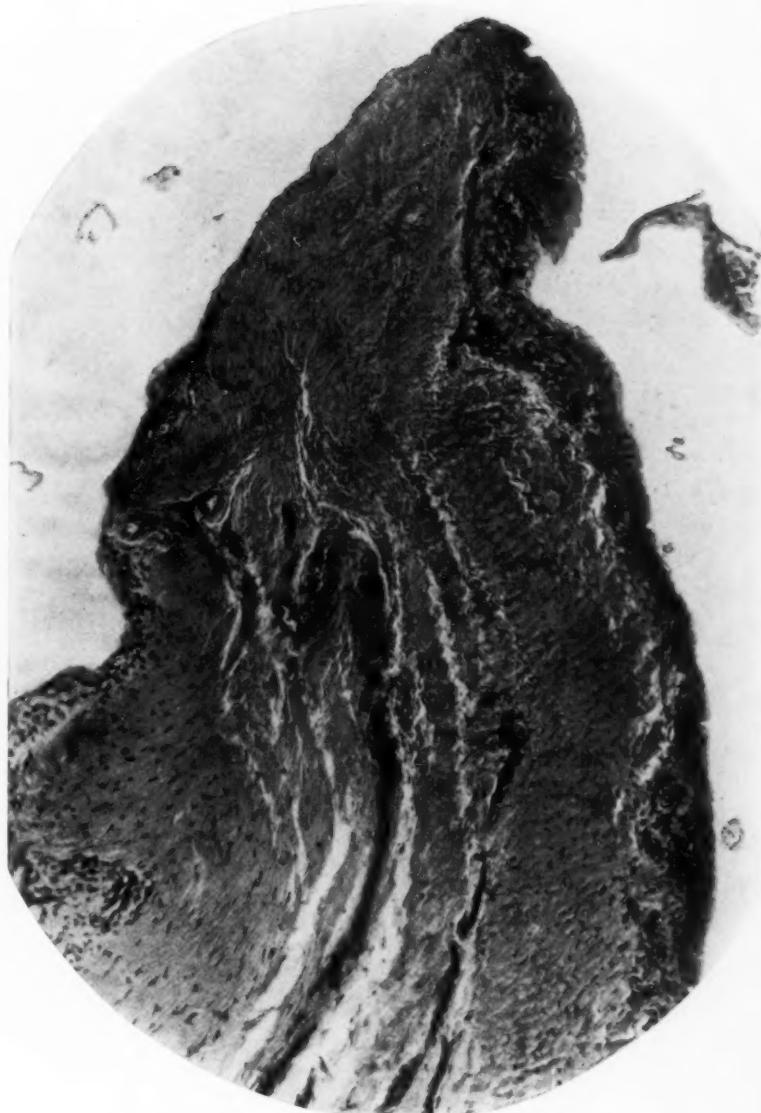
Solid tabs from infrapatellar pad.

FIG. 4.



Fringed tab from infrapatellar pad.

FIG. 5.



Microphotograph of tab from infrapatellar pad. Case II.



tion and be more constantly painful. A cross-section of one of these fibrous tabs is shown in Fig. 5. Here the loss of synovial covering over one surface, probably femoral, the presence of numerous vessels near the surface and the complete replacement of the normal fat and areolar tissue by dense connective tissue are well shown.

Acute External Dislocation of the Patella.—This injury was discussed anatomically in my previous paper but at that time I did not realize the part which muscular violence plays in producing it.

J. R., 21, student, was wrestling with a 200-pound friend when his left knee suddenly gave out with some pain. He noticed his patella on edge at the outer side of the joint, and while his friends were pulling his leg he pushed the bone back into place. The leg was put on a ham-splint, and I saw him within a few hours. There was no ecchymosis, very little swelling of the joint, and no great tenderness. A depression could be felt at the inner side of the patella.

Dr. E. A. Codman saw him with me and agreed as to the desirability of operative repair. December 17, 1906, at the Stillman Infirmary, the joint was opened through a vertical incision internal to the patella. The skin and superficial fascia were the only protection to the joint. The internal patellar ligament, the insertion of the lower portion of the *vastus internus*, and in fact, everything that makes up the capsule was torn from the inner side of the patella and its tendon, and the lower part of the *vastus* was split horizontally from the rest of the muscle. The capsular rent was therefore about five inches long, and the separation an inch and a half. Incidentally the rent had torn away the inner side of the prepatellar bursa opening this into the joint-cavity. No difficulty arose in suturing the parts back into place, a silk-worm gut drain was left in, and he was put to bed with a ham-splint. One of the skin sutures caused a little annoyance but otherwise his convalescence was uneventful. He left the hospital on the eighteenth day with 80 degrees of painless motion. One month later he had given up his cane and enjoyed dancing a whole evening, and on February 19 there was no limp, very little thickening anywhere about the joint, and painless flexion of over 130 degrees.

So far as I know there is no published record of immediate repair of this injury. Two acute cases have been dissected and described—one at autopsy, and the other after amputation of the otherwise injured thigh. In no text-book is immediate repair even suggested as far as I have gone through them, and yet such repair as takes place without suture leaves the joint particularly liable to recurrence of the accident. In fact nature's repair of the condition as I saw it and as before described might leave a man more disabled than nature's repair of the torn patella and aponeurosis.

I am confident that no surgeon who realized the degree of separation and length of scar-tissue required to fill in the gap would allow a patient to recover with such a deficiency and probable recurring trouble if conditions were suitable for operating. The annoyance of the slipping patella is well known.

Bursæ.—Many bursæ give no symptoms whatever and produce no deformity to cause their owners uneasiness. The worst that can come from leaving such undisturbed is an increase in size with corresponding discomfort or æsthetic annoyance to the patient. The most common bursa to be shown the surgeon is the prepatellar. It may be dissected out and removed entire. This can be done with cocaine, but would not be done on me without general anaesthesia. A certain amount of rest would seem desirable until the raw surfaces lose their sensitiveness.

I have treated eighteen by stabbing them at their lowest point, cutting upwards until the hole will admit a cotton swab in a pair of snaps, pressing out all the fluid and fibrin masses, scrubbing the interior thoroughly with a carbolic acid swab, and leaving in a bundle of sterilized silkworm gut for a drain. If the drain is not used I do not think the result is certain for the sac usually fills again. With the drain left in until nature treats it as a foreign body, I have always been successful in abolishing the sac. If the skin be cocainized before the stab the rest is almost painless, and immediately after the patient can walk and work, except kneeling, with comfort.

Complete obliteration may take three or four weeks, but usually about ten days.

The prepatellar bursa never communicates with the joint-cavity except that also be distended with fluid and this condition I have seen but once, and then after an acute external dislocation of the patella. The bursal sac is single and never lobulated to a degree that prevents a free scrubbing of its whole interior. For this reason it is well adapted to the treatment suggested, which is not recommended for any other bursa about the joint.

There is no other bursa about the knee except the one under the patellar tendon which does not at some time communicate with the joint-cavity. Consequently I prefer to dissect out all other bursæ.

These appear in various situations external to the fibrous capsule, and sometimes seem like hernias of the synovial lining. They are painless unless inflamed or pressing on some nerve, though they are often inconvenient. It is a help in determining whether a bursal sac communicates with the joint to remember that the capacity of the joint itself is greatest in 30 degrees flexion, much less in extreme extension, and least in extreme flexion. Therefore a sac flaccid at 30 degrees flexion and tense in the extreme positions differs from one of equal tension in all positions in being probably an extension of the joint-cavity.

It is hardly worth while to give a case to illustrate the treatment of housemaids' knees. They are alike except that the old cases containing fibrin masses are slower in healing than those which still contain some blood or blood-clot. There is always some redness and throbbing and usually a little purulent discharge before the healing is complete.

A case of *enlarged bursa about the biceps insertion* was G. P. W., 39, male. Symptom: Pain in course of left external popliteal nerve. History: For about ten months he had noticed a swelling on outer side of left knee. Examination: Swelling anterior to and just below the long insertion of the biceps cruris,

movable, tense in all positions, but containing fluid. June 11, 1904, this was dissected out at the Boothby Hospital. It was lobulated, one portion resting directly on the external popliteal nerve, and had become shut off from the general joint-cavity, though its former connection was still apparent as a funnel-shaped depression. He went home the third day and into the woods a week later for his usual vacation.

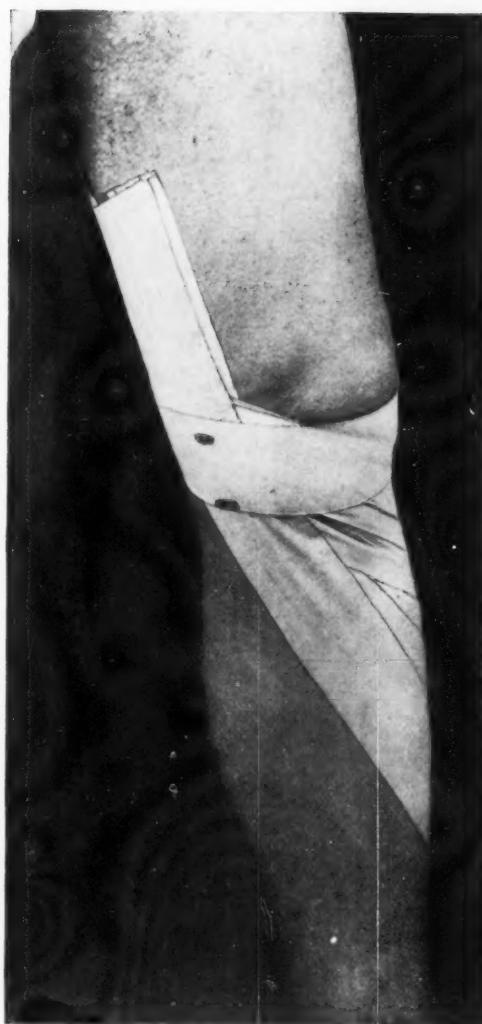
Dislocation of the Semilunar Cartilages.—Though I have seen a large number of cases of internal derangement of the knee-joint, there have been comparatively few which have seemed to me to be injuries of the semilunar cartilages, and of these I have operated but one.

What has seemed to me important in reviewing the notes of my paper of 1904 is that the over-riding of the internal semilunar by the femur has so small a place in operation reports. On the other hand, tears of the internal semilunar between its anterior attachment and its attachment to the internal lateral ligament are often reported by operators. The reason for this is to be found in the fact that any mechanical interference with extension of the knee leads to greater disability and causes more pain than an equal interference with flexion.

To carry weight on a fully extended knee requires no muscular effort compared with that required if the knee be flexed, and abnormal muscular exertion brings noticeable fatigue if not actual pain. Therefore the surgeon is sought for relief. Further as our usual incisions do not disclose the posterior part of the cartilage, posterior injuries may be overlooked. Some further experiments on cadaveric knees have carried out the conclusions previously arrived at as to the results of rotation of the leg after section of the internal lateral ligament between its attachments to the internal semilunar and the *femur*. There is always increase in lateral motion and external rotation and the back portion of the cartilage can be caught between femur and tibia.

If, on the other hand, the ligament be cut between its attachments to the semilunar and the *tibia* there is less increase in lateral motion and rotation, but with external rotation there

FIG. 6.



Spiral adhesive dressing. The two dots indicate the two ends of the internal lateral ligament.



is very marked tension on the fore part of the semilunar which draws the cartilage into the space between femur and tibia. If in life while this space is obliterated by body-weight the same sequence of events occurs, rupture of internal lateral ligament below semilunar and forcible external rotation of the weight-bearing foot, it is extremely probable that the semilunar will give way at its weakest part which is its anterior attachment, or between this and its middle. The consequent limitation of motion and its complete cure by operation is well known and calls for no discussion.

I wish to emphasize the connection between ligamentous and semilunar injuries, because damage to the lateral ligaments is a very common injury often concealed under the name of "sprain" or "acute synovitis," and because proper diagnosis and treatment of injuries to the lateral ligaments are essential not only for the present comfort of the patient, but to prevent misfortune later when the violence may be less and the consequent disability greater by reason of rupture or dislocation of a semilunar.

Diagnosis of injury to the ligaments is easy in most fresh cases on account of the sharply localized tenderness over one or both bony attachments. In more severe cases where there has been complete avulsion and the joint is filled with blood there is a noticeable increase in lateral motion and external rotation, both of which are painful even after months.

Treatment of this condition should vary with the severity of the injury. With the slightest degree of damage as estimated by the increase in movement before described, the essential thing is to take strain off the ligament by keeping the knee in internal rotation and slight flexion. This can be done by a Schaeffer splint better than by any other apparatus known to me, but properly applied adhesive strips serve nearly as well, are always at hand, and require no fitting. The accompanying photograph shows an arrangement which I have used with satisfaction for the past five years.

If the injury to the ligament be fresh and severe enough to increase the lateral and torsion movements decidedly, I fully

believe that the obligation to open and repair damage is greater than with fractured patella. In both cases there is blood in the joint-cavity which will favor adhesions, and in both cases the torn surfaces are separated by blood-clot and ragged weak tissue. Nature's coaptation and repair of a ruptured lateral ligament is likely to leave the patient more of a cripple than the longest sort of a "fibrous union" patella.

The few patients with fully ruptured lateral ligaments whom I have seen some years after their injury and conventional treatment with plaster cast and massage were either on crutches or "getting along" with some sort of splint apparatus. Their condition might be worse, but to-day they ought to fare better by reason of accurate diagnosis and careful coaptation and suture.

CONCLUSION.

1. Asepsis and drainage are more essential in knee-joint work than in laparotomies because of the difference in the skin of the operative fields and in the natural drainage of the two cavities.
2. Sepsis and immobility mean ankylosis. Drainage and mobility may leave some motion.
3. There is an increasing tendency towards operative repair of patellar fractures and an increasing use of absorbable material. This should be the rule to which exceptions may sometimes occur.
4. By far the most common mechanical cause of trouble within the joint is the tab from the infrapatellar pad. This may be a part of a general obesity in which case the usual anti-fat treatments are appropriate. If it be found in a vigorous and otherwise normal person it should be removed. Some temporary relief may be obtained by properly applied adhesive straps, but a cure only by removal.
5. Prepatellar bursitis can be cured by incision and drainage. Other bursæ should be dissected and removed.
6. Ligamentous injuries must be carefully treated and some must have operative repair to prevent recurring or constant disability. No apparatus is so good as a normal knee.

THE OPERATIVE TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR IN ADULTS.

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IN the treatment of fractures of the neck of the femur, operative intervention is indicated when conservative treatment has resulted in non-union or when the break is of such a character as to render this result highly probable. These indications do not apply when the general condition of the patient, either as the result of infirmities or age, is such as to influence unfavorably the prognosis. Non-union, without pain or without marked functional disability,—*i.e.*, firm connective-tissue union,—without severe symptoms, is not an indication for operation. There are rare instances when other operative indications obtain. Gérard reports intra-articular suppuration, secondary to a bed-sore, developing in the course of the treatment of a break of the neck of the femur and Moore has reported a case of compound fracture of the neck of the femur.

It is absolutely essential, for the purpose of deciding definitely upon the method of treatment, to know the line of fracture as far as is possible. For this reason a good radiograph is a *sine qua non*. In an older person no impacted fracture is immediately operable. This type of break becomes operable when the subsequent developments prove that the impaction present did not influence the process of repair sufficiently to obtain union.

An impacted break demands operation only when the patient is relatively young, and when at the same time the impaction is such as to greatly diminish the use of the leg, either as the result of pain or because of deformity. Impaction is either the result of the neck being driven into the head-

fragment or because the base of the neck is driven into the trochanter. If the neck is driven into the head in such a manner as to result in marked displacement of the head-fragment, usually downward and backward, and should it on manipulation not be possible to separate the fragments for the purpose of re-approximation, then an open operation may eventually be indicated.

A simple osteotomy, or a wedge-shaped osteotomy, may allow correction of the deformity. Should it be found at the end of one year after injury that the head of the bone is immovably fixed in the acetabulum and that there is with union sufficient deformity to interfere seriously with function, then a subtrochanteric wedge can be removed. It is my opinion that this operative procedure should not be undertaken until sufficient time has elapsed to allow union to occur,—therefore not inside of one year after the injury,—the reason for this delay being that no theoretical considerations based upon the study of an X-ray plate can demonstrate beyond question what the final functional outcome will be in a given case even when the displacement seems such as to preclude the possibility of a good useful hip. Another objection to early operation is that it is not possible to separate the fragments without further damage to the circulation,—and therefore if we are not going to run the risk of favoring non-union because of additional interference with the circulation,—we must wait until the blood supply has completely readjusted itself after the injury. If, after proper delay, it be found that the head-fragment is so greatly changed in shape that correction is out of the question, then it may be excised as a last resort, provided of course that the symptoms present can be attributed to the conditions at the seat of fracture.

If the neck is driven into the trochanteric region, no open operation will be immediately necessary. When at the time of injury the adduction, rotation outward and upward displacement is sufficient to produce deformity which would subsequently endanger function, then the impaction can be broken up and the fragments readjusted by abduction. In old

injuries where the neck is driven into the head, the operative indications are the same as in recent cases, but when the neck is driven into the trochanter in such a manner as to produce great functional interference, a wedge-shaped osteotomy (antero-superior of the neck or subtrochanteric) will be necessary.

In old people no impacted fracture, however bad the condition, demands operative interference and the abduction treatment with breaking up of the impaction emphasized by Whitman, should not be abused by application to these unsuitable cases of old age.

No non-impacted fracture in a healthy robust adult in middle life or younger is immediately operable, except in such rare cases where the head-fragment is completely turned around in the acetabulum so that the cartilage surface is in contact with the fracture surface of the shaft-fragment. When the break is close to the head the operative indications depend upon the health of the patient and upon the time which has elapsed since the injury. If the patient is robust and the break recent, an open operation is contraindicated. I do not even see any advantage in the use of Nicolaysen's method in these cases, and believe that in a fresh break the approximation produced by abduction and maintained with plaster is quite as efficient as the same treatment combined with the spike driven through the trochanter, besides having the additional advantage of avoiding infection along the track of the fixing metal. If after two and one half months it is apparent on examination that no attempt at union exists, an open operation is indicated. The data which form the basis of believing the absence of any attempt at union are: ability to push the trochanter upwards, and rotation of the trochanter in an arc smaller than on the other side. In a doubtful case two radiographs can be taken, one with the leg lying at ease and one with pressure upwards on the leg,—the difference will be apparent immediately. Crepitus is not often obtainable at this time, although a soft grating sensation may frequently be appreciated in cases where a neoarthrosis is forming. The head in such an in-

stance (Fig. 1)—*i.e.*, break close to cartilage, and no attempt at union,—should be excised. Excision is to be preferred because the circulation has been demonstrated to be insufficient to favor union even after adequate approximation and fixation.

This decision can be reversed only in cases where interposition of tissue found at the time of operation is evidently to blame for non-union and when it is found that the circulation of the head-fragment is good.

To decide whether there is sufficient supply of blood or not it is essential to have the wound absolutely dry so that no oozing will trickle into the fracture-cavity. The fracture cleft is packed tightly with gauze which is allowed to remain for a few moments; on removal of the gauze the fracture surfaces will be examined. In most instances where the circulation is insufficient, the entire fracture-surface of the head-fragment will appear yellowish-white with areas which are smooth and glisten showing where the shaft-fragment rubbed. About the edges wherever a little synovial membrane is still attached, there will be seen irregular bluish patches indicating some slight blood supply (Fig. 2). The ischaemic central area, when curetted, does not ooze—the bone seems dry and friable. The marked difference on the shaft-fragment is most striking. Portions of this will be covered with new connective tissue and if the bone is curetted, the surface oozes freely. The general appearance after removal of connective tissue is that of cancellous bone with abundant circulation.

If the patient be aged but still in good general health, the head fragment should be excised within a few days after the injury (Fig. 3).

The patient cannot afford to stay in bed for the time necessary to permit of union with a break close to the cartilage and then have non-union as the result of the treatment. A stiffly ankylosed but useful hip without pain is preferable. After months of treatment,—and prolonged pain connected with early attempts to walk, the general condition is so run down that an open operation with subsequent bed-treatment is out of the question.

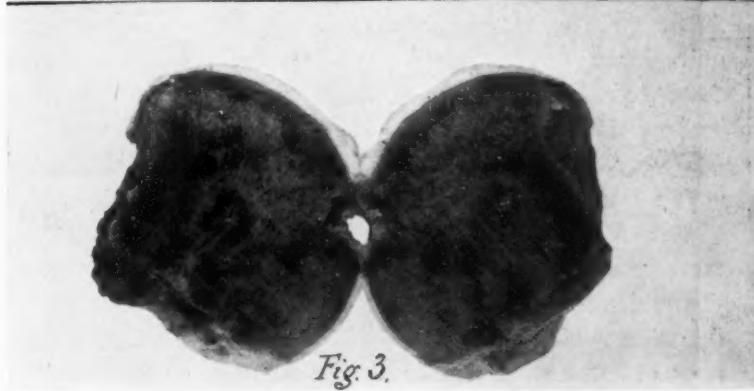
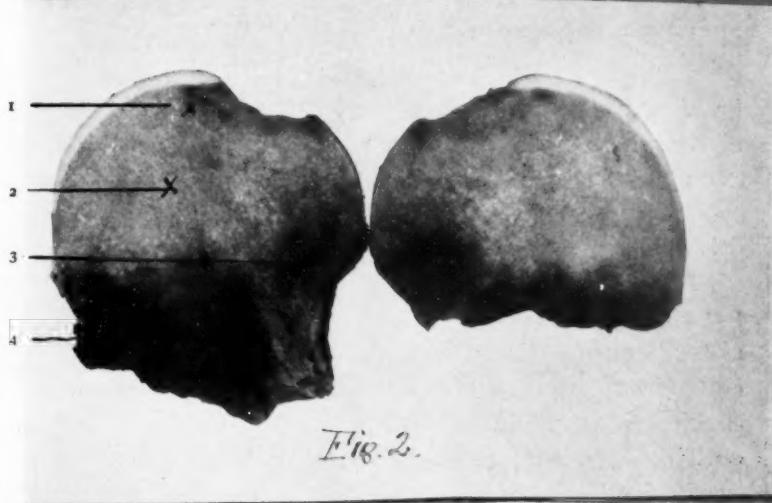
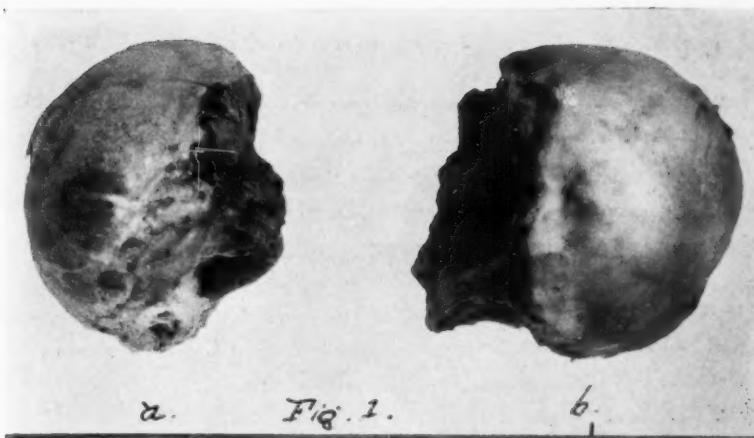


FIG. 1.—(a) Break close to cartilage. Specimen removed one week after injury. No impaction. Woman 65 years of age. (b) Break oblique close to head. Specimen removed three months after injury. No union. No circulation. Man 30 years old.

FIG. 2.—Shows Fig. 1 (b) cut. 1. Slight circulation in region of ligamentum teres. 2. Centre of head yellow, fatty, degenerated. No circulation. 3. Area of circulation close to attachment of synovial membrane. 4. Blood-stain from operation.

FIG. 3.—Shows Fig. 1 (a) cut. Mottled appearance due to areas of blood containing cancellous tissue. Fracture surface, did not ooze.

FIG. 4.



Fracture of neck of femur. Break apparently well out toward trochanter specimen. Fig. 1(a) illustrates deception of radiograph.

When the break is of the middle of the neck and the patient is robust, there is a chance that non-operative care will result in union. It is extremely difficult even from a radiograph to state the exact course of breaks in this region. The radiograph may appear to show the break farther out as a whole than most of the fracture really is (Fig. 6), as is shown in the accompanying illustrations both of which are from the same case (Fig. 1, *a* and Fig. 4).

If at the end of two and a half months, it is evident that union is not likely to occur, an open operation is indicated. Whoever is in the habit of testing can easily detect the signs above referred to which mean absence of any valuable attempt at union.

The operation indicated, provided the circulation allows, is to fasten the two fragments together by means of a bone peg. In as much as the patient is presumably in good condition, this more accurate means of obtaining approximation and refreshing of surfaces is to be preferred to Nicolaysen's method of nailing which is less accurate and does not permit of refreshing the fracture surfaces. The disadvantage of using a metal peg is that it always becomes loose and in the majority of instances has to be removed. The metal does not serve its fixing purpose any longer than the bone peg, which is finally absorbed.

Frangenheim has demonstrated that ossification of the connective-tissue union is not liable to occur much inside of one year. It is therefore evident that if we are to run no risk, weight must not be borne on this thigh inside of one year although it would seem reasonable, that assuming the upright position with the corresponding physiological strain, would tend to favor the deposition of bone in such a manner as to restore the weight bearing trabeculæ. The early months may be passed in plaster, the later ones with a metal hip-splint.

After an operation no test but use will disclose the condition at the seat of fracture. We are sure of approximation and fixation and know that no intervening tissue prevents

union and therefore it is best to delay this test of use until time has given the connective-tissue union opportunity to ossify.

In non-operated cases which are going to unite the connective-tissue union is so firm that it is impossible to detect an abnormal joint. In fact this connective-tissue union may be so short and solid that on resuming use of the leg it may be some weeks or months before the connective tissue stretches sufficiently to give symptoms proving that the assumption of bony union was erroneous.

It is my opinion that some cases which would have ossified eventually do not do so because the patients are allowed to walk and bear weight too soon. The irksome trial of waiting with an apparently good union is hard to bear. Even in cases where connective-tissue union is to be the outcome, it is far better to wait until this connective tissue is firm than to run the risk of stretching by too early straining of the new tissue. After the patient has been permitted to walk even in cases where abundant time has been allowed for union, it may become apparent within a few weeks or months that an abnormal joint exists associated with such disability and pain as to render excision of the head imperative. It is apparent then that a robust individual is obliged to sacrifice one year for the chance of saving the head-fragment in cases where the break is distinctly in the middle of the neck and it is therefore equally apparent that the operation of pegging should not be recommended unless the conditions are such as to render it highly probable that the outcome will be favorable. It must be borne in mind that even in non-operated cases it may not be possible to detect neoarthrosis until the patient walks with full weight; but in most instances two and a half months will be sufficient to make sure of the condition.

At the time of operation, *i.e.*, two and a half months after the injury, there may be found present in the neck, conditions which preclude a fixing operation. The crushing of the neck may have been so extensive or the break may have been so irregular that no approximation favorable to subsequent union

is possible. In such an instance the head-fragment will be excised immediately.

Again there may be found in the neck-fragment, cystic spaces chiefly toward the anterior surface. These may be small or occupy almost the entire diameter of the neck. These spaces may form recesses connecting with the general fracture-cavity, or they may be entirely separate, and broken into when curetting the surface for the purpose of examining the circulation of the fragment. The contents is like the usual fracture-fluid in an old fracture-cavity; it is reddish-brown, slightly cloudy, without any evidence of blood-clot. The walls of the cysts, which have come under my observation, in three cases, were not covered with connective tissue,—simply bare cancellous bone. The spaces are probably due to modifications of the cellular elements of the cancellous bone secondary to impaired nutrition, which in turn is due to interference with the circulation. They correspond possibly to similar cyst forming degenerative changes observed elsewhere in the connective tissues of the body. In the instance of a woman about forty, there was one cyst about one inch in diameter near the anterior wall of the neck. The break was about six months old. In another case, a man of fifty-eight years, there were several small cysts. This break was of fourteen months' duration. In another case, a man thirty years of age, there was one large cavity which communicated with the fracture-cavity. This break was of about four and one half months' duration. The first two were transverse breaks in the middle of the neck; the latter was oblique, close to the cartilage line. The spaces contained no dead bone. These cysts when large, preclude approximation and unless the circulation of the remaining portion of the neck is very good, the head had better be excised. In an aged person with a break of the middle portion of the neck, no open operation for the purpose of approximation and fixation is ever indicated. The outcome of such operations at my hands has not been favorable. These people have not time or vitality which enables them to spend one year with a doubtful outcome at the end of this time.

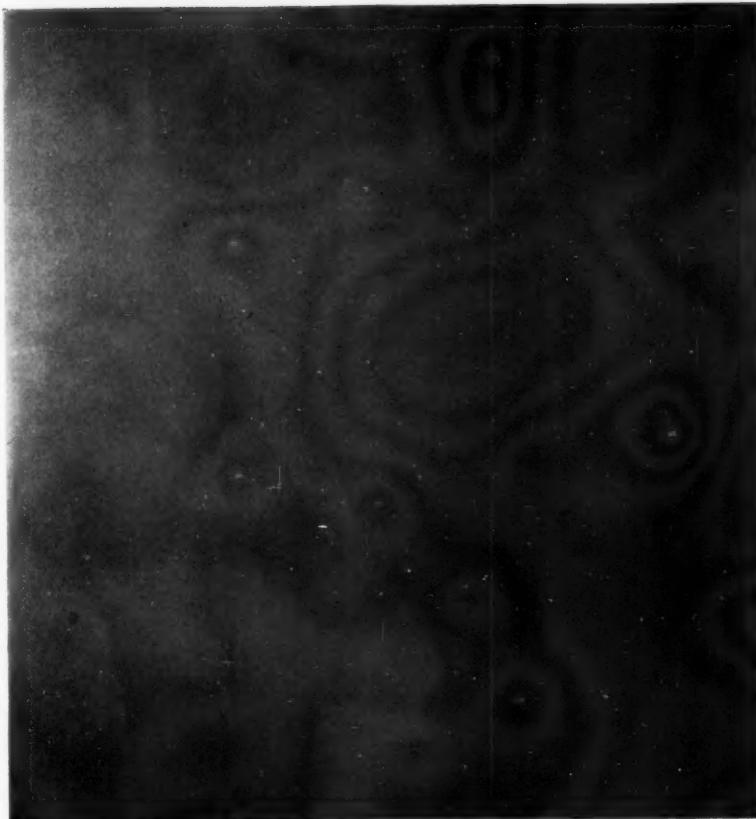
Nicolaysen's operation has been recommended for these old people, for instance, by Cobb. As already stated, it is my opinion that abduction with plaster fixation is to be preferred, and should subsequent examination reveal a neoarthrosis, or non-union, it is better to excise the head, provided the patient's general condition permits.

If the injury be old when first seen, the only treatment in cases of non-union, is to excise the head whether the patient be aged or young.

If a neoarthrosis has existed, even a few months without proper fixation, there is upward displacement, rotation outward and adduction. Even though traction is applied for some time, it is usually not possible to restore the normal position of the fragments. The neck of the femur gradually becomes absorbed,—both the piece connected with the head and the fragment attached to the shaft. This absorption continues until the trochanter base of the neck comes in contact with the brim of the acetabulum, hence the protected head remains intact (Fig. 5).

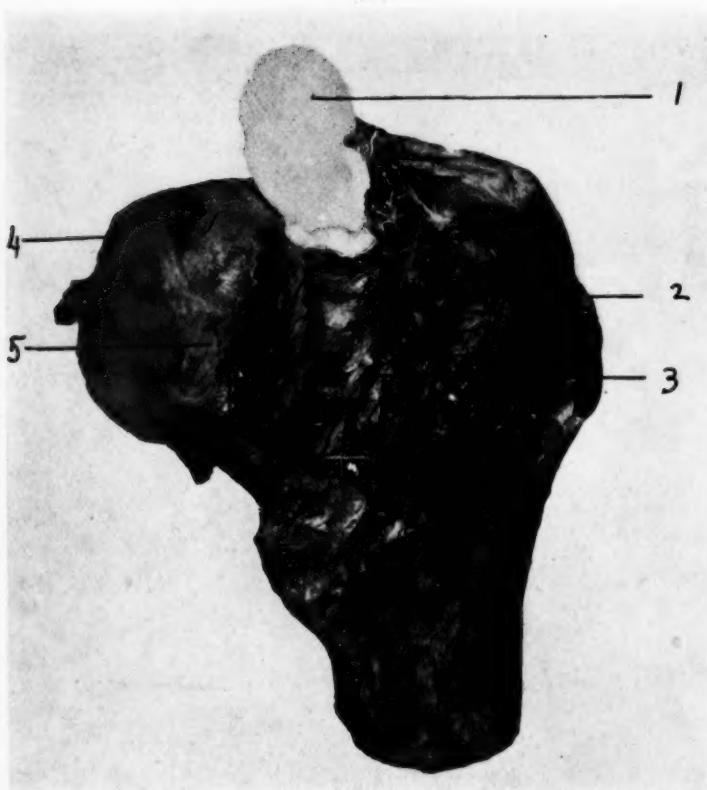
Even when absorption of the neck is not complete, any operative method aiming at approximation and fixation is not feasible for the following reasons: The head itself has become fixed in the acetabulum; there is connective-tissue union between the central portion of the acetabulum and the head itself. The cartilage in this region is destroyed. Where cartilage is opposed to cartilage, however, there is no destruction and no adhesion unless there has been an injury of this particular region (Fig. 6). The absorption of the neck progresses in a plane which corresponds to the rotated outward, abducted and upward displaced shaft. Should it be possible to restore the fragments to their normal level, it will be found that after placing the shaft-fragment in its physiological position,—therefore after correcting the adduction, abduction and upward displacement,—that there is a gap between the fracture surfaces. This gap is widest below and behind. Only the upper and anterior portion of the neck will be in contact. In cases which have existed a long time, it is

FIG. 5.



Fracture of neck of femur. Woman 55 years of age. Break 3½ years; Almost complete absorption of neck. Marked pain. Treatment: Excision of head; fixation of shaft to pelvis.

FIG. 6.



Fracture of neck of femur. Break middle of neck. Young man. False joint. Fibrous union. Specimen obtained after death several years later. (Case of Dr. Marvel, Long Branch, N. J.)

1. Gauze in abnormal joint. 2. Fibrous union; surrounding neck and forming capsule for new joint. 3. Edge of normal capsule (cut away). 4. Cartilage destroyed opposite centre of acetabulum. 5. Normal cartilage opposed to cotyloid cartilage of acetabulum.

not possible on manipulation to overcome the adduction enough to restore the shaft even to the normal straight position without division of the adductors. These conditions prevent approximation and fixation in the normal straight position, to say nothing of a slightly abducted position which would be preferable.

It is therefore best to excise the head. This applies to old fractures in the young as well as in the aged. Six months of non-union will show the effects of absorption and one year will make changes enough to preclude any fixing operation. In most instances the neck will be completely absorbed at the end of two and a half years (Fig. 5). It is therefore apparent that as a rule no matter what the age of the patient, excision will be resorted to in cases of non-union which have existed for one year. To fix the two fragments with the thigh abducted and rotated outward so as to obtain approximation is to court failure because of the subsequent functional disability due to malposition. Even if union did occur a secondary subtrochanteric osteotomy would be necessary to relieve the deformity.

Whenever non-union occurs with a break at the base of the neck, a very rare complication of this accident, the same indications apply as with breaks in the middle of the neck. The decision will be modified more often in favor of saving the head-fragment because of the better conditions of the circulation in the neck-fragment. Base fractures have a tendency, particularly when the trochanter itself is injured, to throw out a great quantity of callus and to form osteophytes which may obstruct union. This callus formation has given rise to operative interference, but personally I have had no experience with a case in which it seemed to be wise to interfere with the callus because of the limitation of motion.

Operation for Exposing Seat of Fracture.—The exposure which seems to me most desirable is obtained in the following manner:

The skin incision carried to fascia, extends from about $1\frac{1}{2}$ inches behind the anterior superior spine on the crest of

the ilium downwards and backwards to the posterior margin of the trochanter, and then vertically down the thigh about 5 inches (Figs. 7 and 8). The skin behind with fat is now

FIG. 7.

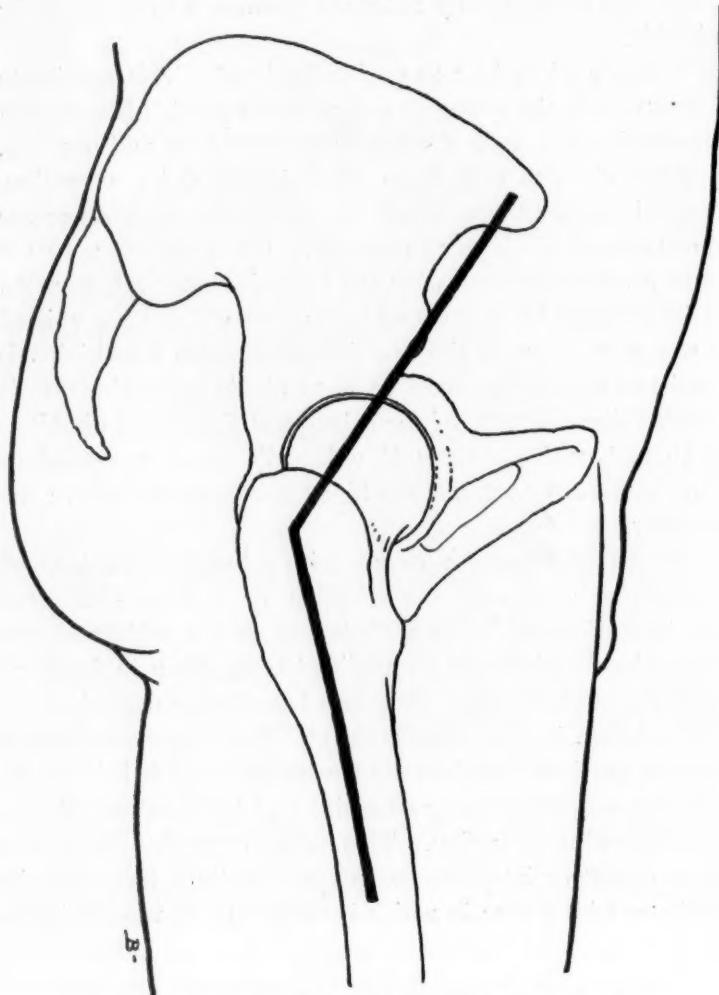


Diagram showing relation of line of incision to bony landmarks.

separated from the fascia overlying the tensor *vaginæ femoris*, leaving the anterior skin-flap in place. The fascia is divided along the posterior margin of the tensor *vaginæ femoris* from

FIG. 8.



Skin incision.

FIG. 9.



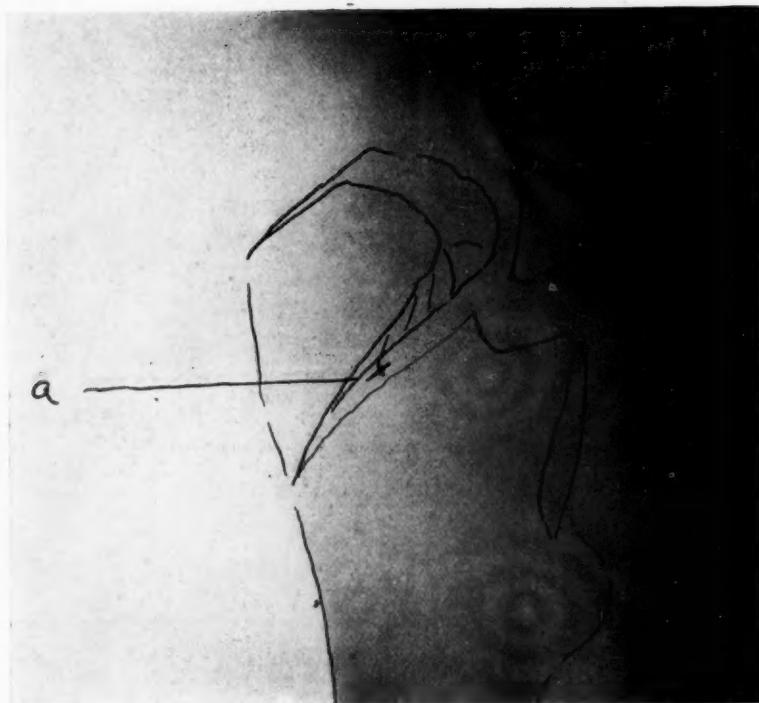
Division of fascia and tendon of tensor vaginae femoris.

FIG. 10.



Tensor fasciae latae pulled inward, exposes triangle from which fat pad has been removed. Internal boundary: rectus femoris. Superior boundary: blended margin of gluteus medius and minimus. Inferior boundary: vastus externus. Floor: capsule of joint with "y" ligament. Anterior margin of greater trochanter crossed by external circumflex vessels.

FIG. 11.



Illustrative case. Excision of head. Remnant of neck in acetabulum; (a) osteotomy of trochanter; good functional result. No pain and $\frac{1}{2}$ in. shortening; slight motion at hip.

the crest of the ilium down to the tendon, and the tendon itself is divided from behind obliquely downwards and forwards (Fig. 9). This skin-subcutaneous fat fascia and muscle-flap is turned forwards, exposing a triangle bounded above by the fused margins of the gluteus medius and minimus, internally by the rectus femoris and inferiorly by the vastus externus. This triangle is filled with a fat-pad and is traversed in the lower part by branches of the external circumflex vessels. This fat-pad is excised in toto to expose the floor, which is formed largely by the anterior margin of the trochanter major, the capsule of the hip-joint; the antero-external brim of the acetabulum. The inner boundary of the floor is the external margin of the ileofemoral ligament. The digital fossa is exposed above, and along the margin of the acetabulum, the reflected head of the rectus femoris (Fig. 10).

By rotating the thigh slightly outwards, the exact seat of the break can be felt. The capsule is divided by an incision starting at the brim of the acetabulum close to the thick fibres of the "Y" ligament, and carried downwards close to this ligament until opposite the place where the external part of the capsule becomes attached to the neck; the incision is then carried upwards dividing the capsule on the neck close to the bone. When this triangular flap is retracted, the break is easily examined. Should it be found, on exposing the floor of this triangle, that the break is partly inside and partly outside of the capsule, great care should be taken not to divide the portion of the capsule attached to the head-fragment. Plenty of room can be obtained by dividing the portion attached to the shaft-fragment anteriorly and below.

By abducting and rotating outward, a very good view of the fracture is obtained. At this point the fracture-cavity should be carefully packed with gauze and the operation delayed for a few moments to allow checking of all oozing. On removal of the gauze the condition of the circulation in the head-fragment is observed, whether there are ischaemic areas or not; whether the bone oozes after slight curetting, or whether there are cysts or not.

In a case which has existed for some time a new connective-tissue capsule for the neoarthrosis will sometimes be found within the normal capsule and attached to the respective margins of the break (Fig. 6). At first sight this connective tissue will appear as a rather firm connective-tissue union, but if it be cut it will be found that the central portion, corresponding to the cancellous tissue of the neck, presents a cavity filled with a moderate amount of sticky reddish fluid and lined with granulations. In other instances the fracture-surfaces are worn smooth, the head-fragment in particular being devoid of granulations, whereas the shaft-fragment is covered with smooth connective tissue. This condition is found in older cases.

In very recent cases, the fracture-cavity is filled with the ordinary sanguineous fracture-fluid found about most fractures.

If the head-fragment is to be excised, the slight remaining attachments about the neck are divided as well as the connective-tissue union to the shaft-fragment when present. A curved blunt instrument is now inserted between the head and the acetabulum, the head pried off and a stout knife curved on the flat introduced to divide the ligamentum teres. After this has been accomplished, the head-fragment is rotated within the capsule until the smooth articular surface faces outwards. Two blunt instruments are now passed into the acetabulum behind the fragment which is easily forced through the opening in the capsule. It is an advantage to have the smooth cartilage surface present in the capsule opening. This is not possible when there is much neck attached.

The older the injury, the greater the difficulty in removing the head because of the connective-tissue union to the acetabulum. After removal of the head-fragment, the cotyloid cartilage is removed with a large sharp spoon. A transverse osteotomy is done at the base of the trochanter from the digital fossa side. This enables the trochanter to be tipped outwards when the head is placed in the acetabulum. The osteotomy should be slightly oblique and outwards so that the trochanter

may fit in the angle between the shaft and the pelvis. There may be quite an annoying hemorrhage at this point of the operation from the artery lying in the digital fossa.

The anterior inferior margin of the acetabulum should be cut away for the reason that if this projecting lip is left the shaft of the femur will be rotated outward after being placed in the cavity. The periosteum over the brim of the acetabulum, the outer side of the shaft of the femur and the inner side of the trochanter should be stripped up so as to permit of bony approximations.

After the shaft has been placed in the acetabulum, the trochanter is fastened to the pelvis by means of a stout bone peg, and this fixation reënforced by suturing the periosteum of pelvis and trochanter with chromic gut. The operation is in this respect the procedure recommended by Gangolphe (Fig. 11).

In recent cases these steps are exceedingly easy, whereas in older cases great difficulties are met because of the changes in muscles and ligaments. In an old case, it may be necessary after removal of the head to abduct the leg to about 90 degrees, if possible, engage the top of the femur in the cavity and gradually force the leg down. At times it may be necessary to resect the upper portion of the trochanter. If there is much tendency for the femur to leave the acetabulum, it is best to fix the femur to the pelvis by means of a bone peg of 25 F. calibre. The position of the femur should be about 30 degrees abduction with the patella pointing straight upward.

After suturing the capsule fascia and tensor vaginæ femoris tendon with interrupted catgut, the skin-wound is closed with a small rubber tissue drain in the lower angle.

From the time the shaft is placed in the acetabulum until the plaster dressing is hard, an assistant holds the leg in the desired position.

When on operation, examination reveals conditions which permit of an attempt to preserve the head-fragments, the fracture-surfaces are freshened with a curette (Fig. 12). After this, it must be ascertained that the head-fragment is

movable at least enough to allow adjustment with the leg in a corrected position. After this readjusted position has been obtained, preferably with the leg abducted and rotated so that the patella faces straight upward, the neck is bored through the trochanter in the direction of the break, this being inwards, slightly upwards and slightly forwards. The upward and inward direction can be regulated according to the position of the neck but the forward angle must be estimated. One feels the drill pass the trochanter cortex; the next firmer resistance is met in the region of the break and finally the resistance at the cartilage is encountered. The distance in an adult man is about 4 inches and in a woman about $3\frac{1}{2}$ inches (Fig. 13).

The bone peg best adapted is made of the shin-bone of an ox turned on a lathe or sawn out and filed practically round. It is not well to have the peg absolutely round and if turned on a lathe, it should be fluted. The engaging end should be slightly conical for the reason that after removal of the drill and introduction of the peg, some slight motion may take place between the fragments. A shoulder presents, and if the end of the peg exactly fits the opening it will not engage in the drill-hole of the neck-fragment. It is desirable to have the drill of irregular shape fluted because this irregularity enables the blood in the drill-opening to escape. If this opportunity is not afforded the incompressible blood is driven into and injures the cancellous tissue. For the purpose of sterilizing, the peg may be boiled on two consecutive days for about half an hour. I have used such pegs many times in different regions of the body, and have as yet seen no bad results except in the case of an os calcis where, owing to a fault of my own, the peg was not driven in sufficiently through the tendo Achillis and therefore rubbed on the boot.

A large bone peg absorbs in about ten months to one year.

Other Methods of Exposure.—An incision is made downwards from the anterior superior spine. The fascia to the outer side of the sartorius is divided and by blunt dissection,

FIG. 12.



Fracture of neck of femur. Man 34 years of age. Break close to base. 6 months' duration. Suitable for attempt at pegging if operative findings permit.

FIG. 13.



Fracture of neck of femur. Break about one year duration. Man 55 years of age. Bone peg in situ. Border line case, because of changes in neck.

the tensor *vaginæ femoris* being pulled back, the region of the joint is reached (Hueter).

Another variety of the anterior exposure is to separate the muscles to the inner side of the sartorius, penetrating to the outer side of the *rectus femoris*. Both of these wounds are narrow and deep; the exposure for extensive work and examination is not good, retraction is difficult, and the field at the bottom of the wound is small.

The "U"-shaped lateral exposure, without division of the trochanter, is insufficient for exposure. When the trochanter is divided (Gillette), the exposure is very good to be sure, in fact better than any other, but in my opinion the method is unnecessarily destructive and in the event of an excision not being necessary, demands the fixation of two fragments to the shaft.

In cases where an excision is to be considered *a priori*, the method is excellent, inasmuch as an osteotomy of the trochanter is essential to place the shaft in the acetabulum and frequently partial resection of the trochanter is imperative.

Kocher's posterior exposure through an angular incision is far too extensive an operation to be considered in connection with fracture work as Kocher has himself emphasized.

A "T"-shaped incision has been used by Painter. For most work the anterior angular incision above recommended will be sufficient and in cases where excision is contemplated *a priori*, Gillette's "U"-shaped incision with division of the trochanter.

For fixing purposes, wire, screws, nails and bone can be used. A bone peg, such as is recommended by Gillette and Peckham, has the advantage that it can be used of large calibre so that there is less tendency to cut the cancellous tissue because of the strain put upon it. Another advantage is that the material, although foreign, does not necessitate removal as frequently as metal pegs and finally the peg becomes absorbed in the course of time.

I have considered these advantages sufficient to warrant giving a bone peg preference and have therefore always used

a freshly prepared peg. In other regions of the body, I have used ivory pegs but find that although satisfactory, they take longer to absorb. Wire has been used successfully by Koenig and Painter; screws by Trendelenburg, Freeman, Moore, *et al.*, and steel nails by many: Thompson, Painter, Cobb, Gelensky, Herz, Martens, *et al.*

Thompson recommends two nails side by side; Lund fixed the fragments by driving the nail through the head into the acetabulum.

Gangolphe endeavored to prevent the shaft from riding up by detaching the greater trochanter and fastening it to the upper margin of the acetabulum to deepen the socket as it were. (See above.)

Gelensky filled the gap between the two fragments with "ausgeglühter" bone and fixed the bones with Gussenbauer's clamp, which was removed on the 37th day. The pieces of bone were cast off.

After-Treatment.—Postoperative dressing. Whether the head of the bone has been resected or not, the first dressing should be a solid plaster cast extending from the toes to the nipple line with the leg in an abducted position. This position is always possible in resection cases but may not be in cases where a pegging operation has been performed.

This plaster must be so arranged that the wound can be dressed and at the same time the greatest strength must be on the outer side in the region of the hip and waist so that adduction cannot recur. Another essential point is to have the plaster so arranged that during the first weeks traction can be used.

It is therefore best to apply a solid spica from above the knee to the nipple line; over this is placed a strong moulded plaster external splint reaching from the axilla to the toes. This in turn is bound to the underlying plaster by strong muslin bandages. A window is cut in the underlying spica.

At the end of four weeks, the bandages should be removed from the peg below the knee and the knee flexed daily over the edge of the bed. At the end of eight weeks, a fresh firm spica

is applied including the pelvis and thigh, the leg being still abducted.

From this time on it is permissible to allow the patient to use crutches although no weight is to be borne on the leg. When a pegging operation has been done, a Thomas hip-splint should be used from the eighth week on. This splint should be worn for one year—in other words, long enough to give the fracture time to ossify.

In excision cases, at least six months should be allowed to pass from the time of operation before the patient bears weight on the leg.

If, after a pegging operation, the patient is allowed to walk before sufficient time has elapsed to permit of bone being deposited in the newly formed connective tissue, it will be found that in the majority of instances, the patient will be comparatively comfortable at first but that within a few months, as the leg begins to be used more and more, pain reappears together with a varying increase in the amount of shortening with some adduction and rotation outward. The new connective-tissue union was short enough and strong enough to sustain the weight of the patient with comparative comfort for some time, but with increasing use this union stretched and a new neoarthrosis formed. The operation in this instance is not a success for in spite of the fact that for some time the condition is better than before operation, there is a gradual return of the pre-operative conditions. It is not safe to state inside of one year what the final outcome is to be.

Immediately after resuming use of the leg with or without excision of the head, the patient seems much improved for the reason that the adhesions secondary to the operation and the fixation have immobilized the bones sufficiently to prevent pain. It is the pain more than deformity or limp which incapacitates the patients. After a few months' time it will be evident whether or not the relief observed immediately after operation is due to conditions which are permanent.

When the operation with pegging is completely successful, the result is very good indeed. There is no pain, very slight

shortening with objective limp, very little deformity and a perfectly useful leg.

When the pegging operation is less successful there may be union with marked shortening, some abduction and rotation outward, distinct functional deficiency, but still a leg which is serviceable with a cane and without marked pain.

In other cases fairly successful, the connective-tissue union is sufficiently firm and short to give fair functional result with not much pain; often some degree of motion which is probably at the seat of fracture. There is some adduction and rotation outward with shortening and limp. Either of these possibilities is a great improvement over the original condition, because of the absence of pain and better ability to get about.

When the operation is a failure, the condition of the hip gradually returns to what it was before operation and finally assumes the condition observed in non-united fractures of the neck of the femur which have not been operated. At first there is apparent improvement, less pain on motion, greater ability to move the leg, which is particularly emphasized in the ability to push the leg forward and lift the foot off the floor, while sitting in a chair. As time goes on and the strain put upon the leg increases, the symptoms of discomfort increase rather than diminish as in cases where the union, either fibrous or bony, obtained is sufficient to meet the requirements of use. This increase of symptoms is due to the gradual stretching of the supporting structures. The trochanter finally displaces upward on the outside of the ilium.

When the head has been excised, the result aimed at is to have the shaft-remnant of the neck or the upper end of the femur remain ankylosed by bony union in the acetabulum. If there remains some motion at the hip, as is occasionally the case, this fortunate event at the present state of our knowledge must be considered accidental and cannot be attributed to purposely prepared conditions at the time of operation. It would seem as if a long neck-fragment on the shaft protruding into the acetabulum favored this result. It is my opinion that

methods of treatment favoring this result such as passive motion, should not be instituted in the hope of obtaining motion, until sufficient clinical evidence has accumulated to demonstrate the conditions which must be present to expect such an outcome and at the same time protect from displacement of the femur upwards.

The conservative aim must as yet consist in an endeavor to obtain firm ankylosis. Such an individual will have a useful leg, no pain, but some deformity with varying degrees of rotation outward and perhaps adduction. There will be some shortening and objective lameness, which, however, is largely offset in cases which have united with the leg abducted by compensatory tilting of the pelvis and lumbar curve of the spine and which may be relieved to some extent even in cases which have united with the leg straight or adducted by the use of a high sole.

The least desirable result is to have the femur escape from the acetabulum and displace upwards. There is shortening, lameness,—subjective and objective,—rotation outward and adduction. The pain, however, is not as great as a rule as in cases of non-union, where the head-fragment is still in place and corresponds more to the condition of patients who have had non-union for many years and whose tissues have finally become adapted to the abnormal state of affairs in such a way as to lessen the amount of discomfort. The only advantage may be in this instance that the period of extreme discomfort is shortened.

The majority of the patients having had an excision will derive benefit, whereas the outcome of a pegging operation is far more doubtful and should therefore be limited strictly to the very few cases, the characteristics of which have already been enumerated.

THE CONSERVATIVE TREATMENT OF FRACTURES OF THE FEMUR.

NOTE ON THE END-RESULTS OF SIXTY-ONE FRACTURES OF THE FEMUR
CONSERVATIVELY TREATED.

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THERE is at present a manifest tendency towards the operative treatment of recent fractures of the long bones, even when the fractures are not compound. Fractures of the femur, which are generally recognized as the most serious of all such fractures in regard both to their immediate mortality and their ultimate results, appear to offer no exception to this modern tendency, which some surgeons would even dignify by erecting into a rule of practice. It seems incumbent, however, on those who thus seek to alter the traditions of surgery either to demonstrate the evil results which they regard as a necessary consequence of accepted methods, or to bring forward proof that by operation still better results can be obtained, and without unjustifiable risk to the patient. The advocates of operative treatment, in short, should either be able to show that the methods they propose will not increase the immediate mortality, and will greatly diminish or altogether prevent the unfavorable results of conservative treatment; or, failing this, they should at least convince conservative surgeons that the functional results of the accepted forms of treatment are such as can no longer be tolerated.

Sir Thomas Myles (Med. Press and Circular, 1907, lxxxiv, 35), speaking recently of fractures of the femur, said:

* Read before the Philadelphia Academy of Surgery, June 1, 1908.

"My own experience of the result of routine treatment in these cases is not very encouraging. I have found that in nearly all cases occurring in adults there has been considerable shortening and consequent lameness, some stiffness in the knee-joint, some limitation of the movements of rotation at the hip-joint, a varying degree of muscular atrophy, pain with changes in the weather, and almost always an ugly knob of callus to be felt or seen at the seat of the united fracture. . . . At first I felt inclined to blame myself for these results, but further study of the subject soon taught me that they are the invariable and inevitable results of the methods of treatment usually adopted." He adds that it has hitherto been an accepted fact "that shortening of an inch or two is the inevitable outcome of such injuries, and that nothing can be done to prevent it." In support of these positive assertions he calls to witness museum specimens and skiagraphs; but in regard to such testimony we think it should be borne in mind that the former are selected as curios, and hence the chief desideratum is the presence of deformity and exuberant callus; while skiagraphs are notorious for exaggerating any deformity which may exist. Moreover, Myles presents no details of the end-results of the operative treatment which he so vehemently urges.

Among other surgeons who are champions of the operative treatment of recent fractures may be mentioned Lane and Knaggs, in England, and Vaughan and Martin, in this country.

König (Arch. f. klin. Chir., 1907, lxxxiii, 1032) favors operative treatment for recent fractures of the cervix, the trochanters, and for supracondylar fractures; fractures of the shaft he thinks may give quite satisfactory results under conservative treatment.

Bardenheuer (Die allgemeine Lehre von den Fracturen u. Luxationen, Stuttgart, 1907, 304), on the other hand, does not favor operative treatment at all; he calls attention to the fact that in spite of the advances in aseptic technic Tuffier among 22 such operations had 3 to suppurate.

The end-results under conservative treatment have not received much attention, with the exception of those of the neck of the femur; most surgeons are content with the "general impression" they have received from the results of the cases under their treatment. In fractures of the cervix femoris the prognosis as to ultimate function has generally been regarded as gloomy; but Mr. Bryant (cited by Stimson: Fractures and Dislocations, New York and Philadelphia, 1899, 326) was much more optimistic as to these patients than most surgeons; on more than one occasion he said that all his hospital cases of fracture of the cervix for many years (42 cases, average age 70 years) "went out with good and useful limbs"; a statement, which, as Stimson remarks, indicates much better results than have been reported elsewhere, even if the standard of "good and useful" is only that the patient can stand and walk a little with the aid of a cane. But it may be recalled that Dr. Le Conte, before the Philadelphia Academy of Surgery (*ANNALS OF SURGERY*, 1905, ii, 284), stated his impression that 80 per cent. of his patients with intracapsular fracture were discharged "with useful and valuable legs."

Scudder (Treatment of Fractures, Philadelphia, 1907, 6th ed., 336) reports the end-results of 16 fractures of the neck of the femur treated at the Massachusetts General Hospital. Only three of these patients were over 60 years of age at the time of the accident. Only two patients had functionally useful limbs, while thirteen had to use a crutch, a cane, or had disability in going up and down stairs. J. B. Walker (*ANNALS OF SURGERY*, 1908, i, 84) has recently published an investigation of 112 cases of fracture of the neck of the femur treated at the Bellevue Hospital, New York. There were 18 deaths, an immediate mortality of 16 per cent. (a number of patients, also, were transferred in a few days to other institutions; if these were included the mortality would probably be higher); 10 patients were still under treatment in the wards; 32 could not be traced; and of the 52 patients who were traced, no less than 30 (57.6 per cent.) were found

to be incapacitated, 12 were still compelled to use a cane, and only 10 (less than one out of five) could do their normal work.

Certainly there is a marked divergence between the results reported by Scudder and by Walker, and those observed by Bryant and by Le Conte.

As a contribution to this subject we have studied 121 recent fractures of the femur which have been under treatment in the Episcopal Hospital during the last three years; and we take this opportunity to acknowledge the courtesy of the staff in permitting us to examine their case-records and their patients. Although there have also been admitted during this time a few patients with ununited fractures of the femoral neck, these have not been included in our statistics, as the object was merely to ascertain the end-results of conservative treatment of recent fractures.

The following classification has been adopted:

Region of Femur Involved.	Condition on Discharge.
Cervix, 58 cases	Cured, 20 patients; improved, 20 patients; not improved, 2 patients, died, 16 patients.
Trochanteric, 13 cases	Cured, 12 patients; improved, 1 patient; died, 0 patient.
Shaft, 32 cases	Cured, 26 patients; improved, 1 patient; died, 5 patients.
Condyles, 18 cases	Cured, 15 patients; improved, 2 patients; died, 1 patient.

There has been no distinction made in our figures between intra- and extracapsular fractures of the neck of the thigh-bone. It is distinctly stated in only two cases that the fracture (cervix) was still ununited on discharge; but it is possible that no union was present in 8 other patients. It is reasonably certain, however, that firm union (probably not bony in all cases) was secured in 29 patients (69 per cent. of those who recovered). We have classed as trochanteric both fractures

"through the trochanters" and "subtrochanteric" fractures; and among fractures of the condyles are included, besides 15 typical "supracondylar" fractures, also 2 cases of fracture through the external condyle, and 1 case of compound epiphyseal separation, all three of the last-named fractures involving the knee-joint.

The mortality among these 121 cases was 18.1 per cent.

CAUSES OF DEATH.

The causes of death may be seen in the following table:

Cervix, 16 deaths, mortality 27.6 per cent.: shock, 2 patients; pneumonia, 3; decubitus, 3; exhaustion, 5; uræmia, 1; cancer of the pylorus, 1; enlargement of prostate, 1. (Age varied from 59 to 84 years, 11 patients being over 70 years; and the period until death varying from 1 day to 10 months).

Trochanteric, no deaths.

Shaft, 5 deaths, mortality 15.6 per cent.: other injuries, 3 patients, aged 76, 51, and 60 years; delirium tremens, 1, aged 33 years; pneumonia, 1, aged 71 years, after five days.

Condyles, 1 death, mortality 5.5 per cent.: oedema of lungs, 1 patient, aged 66 years.

With the exception of the fractures of the neck of the femur there was only one fracture in which on discharge firm bony union had not taken place. This patient, a woman aged 65 years, with a fracture at the junction of the middle and lower thirds of the shaft, went home over ten weeks after admission, wearing a plaster cast, with fibrous union. It has been impossible to trace her since her discharge more than two years ago. Several skiagraphs made while she was under treatment showed good apposition of a nearly transverse fracture.

The treatment adopted has been so various as to be fully representative. While all the surgeons employ longitudinal traction by means of Buck's extension apparatus, some use only sandbags in addition; others will have none of sandbags, but employ Volkmann's sliding splint; and some are partial to the double inclined plane, Smith's anterior splint, and

other more complicated appliances. A number of the fractures of the neck of the femur have been treated with encouraging results by both longitudinal and lateral traction, as advocated in 1869 by Phillips (*Amer. Jour. Med. Sciences*, 1869, lxxviii, 398), and as recently popularized by Maxwell, Ruth, and others.

The ages of these patients varied from 4 months to 86 years.

Notices were sent to all of the 99 patients who recovered. Of these, 29 returned to the hospital for examination; 17 were examined at their homes; and accurate accounts of the present condition of 15 were received from their family or friends. It was impossible to trace 37 patients. There are thus available for our report 61 patients showing the end-results of treatment.

Contrary to our expectation, the ultimate results in those patients who did not return for examination were as good as, and in some instances better than, those in the patients who came to the hospital. Thus one old lady of nearly 70 years, with fracture of the neck of the femur, was found busy house-cleaning, having just moved all her parlor furniture into the front hall and vestibule. Other patients were visited at their places of employment, and were found too hard at work to spare the time to return to the hospital for examination.

We have classed the functional end-results under the following headings: (1) Perfect functional result, which, without regard to shortening, implies the entire absence of limp, and of any hindrance to the normal use of the limb. It should be stated, however, that none of these patients were acrobats, either before or after their injury. (2) No disability but limp. (3) Marked impairment of function, which implies that the limp was decided, and that in some cases the use of a cane, and in a few the use of a crutch, was still necessary, although even these patients were by no means helpless. Thus one patient (*cervix*), included in this class of "marked impairment of function," uses a crutch on the street, a cane at home, goes up and down stairs constantly, and supports herself by the

use of a sewing machine, which she runs with either foot indifferently. (4) Incapacitated, which implies that the patient has to use two crutches, or is confined to the house.

The end-results of the 61 cases may be thus tabulated:

END-RESULTS OF SIXTY-ONE CASES OF FRACTURE OF THE FEMUR TREATED CONSERVATIVELY.

Site of Fracture.	Cases Treated.	Cases Recovered.	Cases Traced.	I. Perfect Functional Result.	II. No Disability but Limp.	III. Marked Impairment of Function.	IV. Incapacitated.
Cervix.....	58	42	21	5	8	6	2
Trochanteric.....	13	13	9	5	2	2	0
Shaft.....	32	25	22	14	8	0	0
Condyles.....	18	17	9	4	3	0	2
Total.....	121	99	61	28	21	8	4

Forty-one patients were examined for shortening; the results are shown in the accompanying table:

SHORTENING.

Site of Fracture.	No. of Patients Measured.	No Shortening.	Shortening less than				
			1 cm.	2 cm.	2.5 cm.	4 cm.	5 cm.
Cervix.....	12	1	3	3	2	2	1
Trochanters.....	6	1	2	.	1	.	2
Shaft.....	17	5	8	4	.	.	.
Condyles.....	6	1	.	1	.	3	.
Total.....	41	8	13	8	3	5	4

Among 41 patients measured, 8, or about one-fifth, recovered without shortening; 32, or 78 per cent., had less than one inch shortening; none of the patients had more than two inches shortening; and none of the patients with fractures

of the shaft itself had more than three-fourths of an inch shortening.

Speaking of fractures of the femoral neck alone, we found entirely useful limbs in 13 out of 21 cases traced, or in nearly 62 per cent. Only two patients were entirely incapacitated: one of these, a woman 80 years old, was discharged with an ununited fracture, and died at her home three weeks later; the other patient, a man 78 years old, was living six months after the accident. The average age of the 21 patients traced was over 57 years at the time of the accident; or, if two children of 11 and 15 years be excluded, the average age of 19 patients was over 62 years; 12 patients were actually more than 60 years old at the time of the accident, and 7 of these were over 70 years. Of the 21 patients with fracture of the neck of the femur who were not traced, the average age was 64½ years, 10 of the patients being over 70 years of age. The difficulty of tracing them was no doubt due in part to some of them being dead.

Taking all the remaining fractures together, excluding those of the cervix, there were 40 patients traced. Of these, 36 (90 per cent.) had entirely useful limbs, though 13 of them had a limp. There was marked impairment of function in 2 patients (trochanteric fractures), one of whom, aged 70 years, had had the same femur fractured once before, three months previously; and the other, aged 65 years, sustained, besides the fracture through the trochanters, a Pott's fracture of the same leg. Two patients in this group were found to be incapacitated; both had supracondylar fractures—one, aged 55 years, had previously sustained a fracture of the neck of the same femur, which had united with shortening and deformity; he still uses crutches, over 18 months after his discharge;—the other patient, a woman of 62 years, has advanced rheumatoid arthritis affecting both knees and both hips; she is barely able to totter around her house.

We may conclude, then, that, with the exception of these four patients, the results of the conservative treatment of fractures of the femur, excluding those of the neck, were satisfac-

tory; and we very much doubt whether operative treatment of such cases could do more than give entirely useful limbs in 90 per cent. of cases, and leave only one out of every three patients with no other functional impairment than a limp.

FRACTURES OF FEMUR, EPISCOPAL HOSPITAL. PATIENTS
TRACED, 1905-1907 INCLUSIVE.

CERVIX.

1. Matthew G., 64 yrs., July, 1907. Examination 2-12-'08. Habitually uses crutch and cane. Can walk without support of any kind. Goes up and down stairs daily. Is still improving. Shortening 3 cm.; eversion; rotation fair. Abduction possible to 30°, flexion to 135°. Union firm. (Class III.)
2. Irene K., 11 yrs., January, 1904. Report 5-13-'08. No limp; all functions perfect. (Class I.)
3. Mary E., 72 yrs., January, 1905. Report 1-21-'08. Can walk with crutches; goes up and down stairs daily. Was treated by longitudinal and lateral traction. (Class III.)
4. John M., 53 yrs., February, 1905. Examination 1-25-'08. Scarcely appreciable limp. Rotation a little restricted; flexion to 90°; abduction to 10°. Union firm. Shortening 1 cm. (Class II.)
5. Chas. M., 35 yrs., December, 1905. Examination 2-10-'08. No perceptible limp. Shortening 2 cm. Flexion normal; rotation normal; hardly any abduction possible. Was treated by longitudinal and lateral traction. (Class I.)
6. Margaret B., 50 yrs., January, 1907. Examination 2-10-'08. Uses cane on street. Marked limp without cane. Eversion slight; rotation fair; abduction and flexion normal. Union firm. Shortening 2 cm. Was not brought to hospital until 5 weeks after injury in 1907. (Class III.)
7. Jane C., 65 yrs., March, 1907. Examination 5-13-'08. Moderate limp; no disability; good union. Found at her home housecleaning, and moving furniture around. (Class II.)
8. Lena M., 56 yrs., February, 1907. Examination 1-23-'08. Habitually uses two crutches, but can walk with only one cane. Very little limp when using cane. Goes up and down stairs easily. Firm union. Shortening 4 cm. (Class III.)
9. Eliza K., 70 yrs., June, 1905. Examination 4-2-'08.

Slight limp, no cane. Goes up and down stairs often each day, but not leg over leg. Eversion slight, rotation slight, abduction to 18°, flexion to 90°. Union firm. Shortening 1 cm. (Class II.)

10. Pauline T., 55 yrs., January, 1906. Examination 3-23-'08. Decided limp; uses one crutch on street, one cane at home. Goes up and down stairs constantly; uses sewing machine all day, working it with either foot indifferently. Rotation good; flexion to 90°, abduction to 20°. Union firm; shortening 2.5 cm. Was treated by longitudinal and lateral traction. (Class III.)

11. Anna C., 35 yrs., March, 1906. Report 5-13-'08. Marked limp, moderate outward rotation; perfect use. (Class II.)

12. Charles W. S., 70 yrs., June, 1906. Examination 4-20-'08. No limp, no disability of any kind. All functions normal. No shortening. X-ray showed fracture through base of cervix. (Class I.)

13. Mary G., 58 yrs., October, 1906. Examination 5-16-'08. Moderate limp; flexion to 90°; slight eversion. Union firm; shortening 5 cm. Scarcely any disability. (Class II.)

14. Jane McC., 78 yrs., May, 1905. Examination 5-20-'08. Very little limp; scarcely any disability. Union firm. No eversion. Shortening 2 cm. (Class II.)

15. Margaret G., 80 yrs., December, 1905. Report 5-20-'08. Died about three weeks after discharge; never left bed after return from hospital. Recorded in hospital records as "unimproved." (Class IV.)

16. Joseph S., 62 yrs., August, 1905. Report 5-23-'08. Moderate limp; always uses cane. Works as watchman. (Class III.)

17. Catharine B., 63 yrs., November, 1907. Report 5-23-'08. Scarcely appreciable limp; no disability at all. Fracture was impacted. (Class II.)

18. John B. M., 15 yrs., October, 1906. Examination 4-20-'08. No limp; flexion to 15° beyond right angle; abduction 5°; shortening 2.5 cm. Typical case of traumatic coxa vara. (Class I.)

19. Joseph K., 68 yrs., July, 1907. Examination 4-20-'08. No appreciable limp; slight eversion; flexion to 15 degrees beyond right angle; abduction 10°. Shortening 0.75 cm. Works as blacksmith. (Class I.)

20. Maxwell L., 78 yrs., October, 1907. Report 4-20-'08. Incapacitated; unable even to use crutches. (Class IV.)

21. Lydia L., 75 yrs., April, 1905. Report 5-28-'08. Died of pneumonia in January, 1907, nearly two years after fracture of hip. Until within a few days of death walked with scarcely appreciable limp, and with no disability. (Class II.)

THROUGH OR BELOW TROCHANTERS.

1. Gottlieb F., 45 yrs., December, 1905. Examination 5-16-'08. No limp; no deformity. Shortening 1 cm. (Class I.)

2. Carrie M., 12 yrs., June, 1906. Examination 5-16-'08. No limp; no shortening. Treated on double inclined plane. (Class I.)

3. Thomas H., 60 yrs., August, 1906. Examination 5-13-'08. No limp; no disability. Had double fracture of femur. (Class I.)

4. Daniel H., 40 yrs., May, 1907. Examination 4-20-'08. Moderate limp; works as rigger at Cramp's shipyard; climbs ladders constantly. Upper fragment slightly displaced forward. Shortening 4.5 cm. (Class II.)

5. Joseph Q., 57 yrs., September, 1906. Examination 4-20-'08. Limp not noticeable; flexion to 15 degrees beyond right angle. Shortening 1 cm. (Class I.)

6. Bernhard P., 43 yrs., March, 1905. Examination 2-6-'08. No perceptible limp; rotation slightly restricted; all other functions normal. Slight thickening through trochanters. Shortening 2.5 cm. (Class I.)

7. Joseph S., 69 yrs., December, 1905. Report 5-13-'08. Very slight limp; all functions normal. (Class II.)

8. Susan D., 70 yrs., July, 1907. Examination 1-4-'08. Walking with cane; slight limp. Had fractured same femur three months before admission for recent refracture. (Class III.)

9. Annie D., 65 yrs., March, 1906. Examination 5-23-'08. Walks around house without crutch; goes up and down stairs several times daily. Marked limp. Shortening 4.5 cm. Had also Pott's fracture of same leg, at same time as fracture of femur. (Class III.)

SHAFT.

1. Harry M., 6 yrs., September, 1905. Report 5-16-'08. No limp; all functions perfect. (Class I.)

2. Franklin C., 18 yrs., September, 1905. Examination 2-6-'08. Scarcely perceptible limp; all functions normal. Shortening 1 cm. (Class II.)
3. Robert L., 53 yrs., October, 1905. Report 5-16-'08. No limp; no disability; wife cannot tell which was the injured side. (Class I.)
4. John B., 13 yrs., October, 1905. Examination 1-28-'08. No limp, all functions normal. Shortening 1 cm. (Class I.)
5. John R., 34 yrs., November, 1905. Examination 3-19-'08. No limp; all functions normal except flexion of knee, which is impossible beyond 35 degrees more than right angle. Shortening 1 cm. Some callus at site of fracture, which was comminuted. (Class I.)
6. Harry D., 7 yrs., February, 1906. Examination 3-19-'08. Very slight limp; all functions normal. No shortening. Limp probably due to fracture of lower third of leg bones on same side, sustained since recovery from fracture of femur. (Class II.)
7. Geo. M., 54 yrs., May, 1906. Examination 5-16-'08. No limp; all functions normal. No shortening. (Class I.)
8. Fred. K. C., 41 yrs., June, 1906. Examination 4-18-'08. Slight limp; all functions normal. Shortening 0.5 cm. Had same hip injured again shortly after discharge from hospital. (Class II.)
9. Benjamin S., 27 yrs., August, 1906. Report 5-16-'08. Slight limp; all functions normal. (Class II.)
10. John K., 15 yrs., January, 1907. Examination 4-18-'08. No limp; all functions normal. Shortening 1.5 cm. Was crushed in elevator, sustaining contusions of pelvis, fractures of left femur, and of middle third of both bones of left leg. (Class I.)
11. John M., 43 yrs., November, 1906. Examination 5-16-'08. Slight limp; all functions normal; shortening 2 cm. Had also fracture of olecranon. (Class II.)
12. George D., 53 yrs., November, 1906. Examination 4-18-'08. Slight limp; flexion of hip only to 10° beyond right angle; all other functions normal. Shortening 1 cm. When 7 years of age had extensive operation on this femur for osteomyelitis. (Class II.)
13. James H., 10 yrs., May, 1907. Examination 4-21-'08. No limp; all functions normal. Shortening 1 cm. (Class I.)
14. William H., 30 yrs., June, 1907. Examination 5-13-'08.

No limp; all functions normal. Shortening 0.5 cm. Had also fractures of both forearms, compound comminuted of left; concussion of brain; and delirium tremens. (Class I.)

15. Albert F., 4 months, September, 1907. Examination 4-21-'08. No deformity; functions all normal. No shortening. (Class I.)

16. John F., 15 yrs., October, 1907. Examination 4-23-'08. No limp; all functions normal. Upper fragment is displaced slightly outwards. Shortening 1.5 cm. (Class I.)

17. William M., 49 yrs., November, 1904. Report 5-18-'08. Committed suicide one year ago. Still had slight limp, but no other disability. (Class II.)

18. Annie K., 70 yrs., December, 1904. Examination 5-18-'08. No limp, no disability. Shortening 1 cm. (Class I.)

19. John S., 8 yrs., May, 1907. Examination 5-18-'08. No limp; all functions normal. Shortening 1.5 cm. (Class I.)

20. Joseph C., 5 yrs., November, 1907. Examination 5-18-'08. No limp; all functions normal. No shortening. (Class I.)

21. Joseph G., 16 yrs., March, 1906. Report 5-23-'08. Very slight limp; no disability at all. Same femur broken twice. (Class II.)

22. Marie K., 2 yrs., August, 1906. Examination 5-23-'08. No limp; all functions perfect. No shortening. (Class I.)

SUPRACONDYLAR.

1. Ungar D., 29 yrs., July, 1905. Report 5-16-'08. Had slight limp two years ago. (Class II.)

2. Samuel M., 44 yrs., September, 1905. Examination 1-30-'08. Scarcely perceptible limp; full extension, but flexion only to 10 degrees beyond right angle. Shortening 3 cm. This was a fracture through the external condyle, involving the knee-joint; and the patient had had a fracture through lower third of same femur five years before this injury. (Class I.)

3. Arthur D., 7 yrs., January, 1906. Examination 3-19-'08. No limp; not quite complete extension of knee. No shortening. This was a compound epiphyseal separation. (Class I.)

4. Nellie S., 27 yrs., February, 1907. Examination 5-16-'08. No limp; flexion of knee only to right angle; all other functions

normal. Shortening 2 cm. This was a fracture of external condyle, involving joint. (Class I.)

5. Mrs. W., 63 yrs., March, 1907. Examination 5-13-'08. Marked limp; no disability. Shortening 3 cm. (Class II.)

6. John D., 45 yrs., December, 1907. Examination 4-21-'08. Marked limp; all functions normal. Lower fragment is posterior and external. Wears heel three-quarters of an inch high. Shortening 4 cm. (Class II.)

7. William M., 65 yrs., April, 1905. Examination 5-20-'08. No limp; no disability. Shortening 5 cm. (Class I.)

8. Hannah C., 62 yrs., May, 1905. Examination 5-20-'08. Crippled by rheumatoid arthritis in knees and hips; barely able to walk; has not been out of house since return from hospital. Does no work. Right knee is more stiff and disabled than the fractured knee. (Class IV.)

9. James McC., 55 yrs., October, 1906. Report 5-20-'08. Incapacitated; still uses one crutch and cane. This fracture involved knee-joint; and the patient had previously had a fracture of cervix of same femur, which had united with shortening and deformity. (Class IV.)

NON-TUBERCULOUS OSTEOMYELITIS OF THE OS CALCIS.

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IN this paper no distinction is made between osteitis and osteomyelitis. The word osteomyelitis has been selected to cover all non-tuberculous inflammations involving the calcaneum.

History.—In 1814 Monteggia excised the os calcis for osteomyelitis and, so far as I am able to learn, the affection had not been given consideration previous to that time. Then for 45 years osteomyelitis of the os calcis does not seem to be mentioned in medical literature. In 1859 Polaillon¹ discussed the condition from clinical and pathological standpoints; and, in the same year, M. Sedillot² elaborated its operative treatment. In 1870 Burrall³ reported a case treated at Bellevue and Fergusson⁴ reported one case in 1874. During the years 1876, '77, and '78, three articles were published regarding osteomyelitis of the os calcis. Vincent⁵ discussed its operative treatment; Lebecq⁶ reported a case in an adult who had sustained no injury to the part; and Schinzinger,⁷ who wrote the most exhaustive article I have been able to find on this subject, reported six cases. Since 1878 Zwicke,⁸ Owen,⁹ and Senn¹⁰ report one case each.

Frequency.—Osteomyelitis of the os calcis is, according to medical literature, a rare condition. Although it has received little attention, it is probable that it occurs more frequently than the reports would indicate. Schinzinger believes that it is not so very rare and says that Ollier knew of 100 cases occurring in 16 years. I have treated 3 cases; and have knowledge of 2 treated successfully but not reported. T. Holmes and M. Markal state that many cases of caries, limited to one bone of the tarsus, are seen especially in children.

Etiology.—Osteomyelitis of the os calcis is as a rule a disease of childhood. Of the reported cases only one (Lebecq's) occurred in an adult. It is found most often between the ages of 6 and 10 years; and, according to Owen is very rare after puberty. It is most often secondary to wounds of the heel, but as in Lebecq's case it may occur unassociated with injuries or local infections. The location and anatomy of the os calcis are factors predisposing to inflammatory involvement of this bone. It is the largest of the tarsal bones and, bearing most of the weight of the body, is exposed to traumatism.

The os calcis, during childhood, may be considered as a diaphysis of spongy bone having a posterior cartilaginous epiphysis. Ossification begins about the tenth year, the two parts of the bone uniting shortly after puberty. Several moderately large arteries and veins enter and leave the os calcis,—especially on its inner side,—affording an opportunity for infection in the soft structures of the heel to invade the bone. It does not seem probable that the lymphatics play an important part in the occurrence of osteomyelitis of the os calcis.

Pathology.—The pathology of osteomyelitis of the os calcis does not differ from that of the same disease in other bones. While it is most often secondary to local infection, it occurs without previous local changes (Owen and Lebecq), and may be a part of infection involving many bones (Owen). Sequestration is the rule, but no sequestra may be found in children under 7 years of age. In patients from 10 to 12 years old one or two large sequestra are frequently found. They are more or less globular and measure from one-half to three-quarters of an inch in the longest diameter. In the museum of St. Bartholomew's Hospital (Sp. No. 195) there is a specimen of osteomyelitis of the os calcis with a large sequestrum. In advanced cases the entire substance of the bone is destroyed, leaving only a thin periosteal shell. But even in these cases regeneration from the periosteum will in time, if the infection has been terminated, apparently completely replace the bone,

diminishing the deformity and rendering the foot functionally perfect.

The bacteriology of osteomyelitis of the os calcis has not received attention. In the 3 cases that I treated, sinuses had formed and mixed infection was present.

Symptoms.—The symptoms of osteomyelitis of the os calcis are the general symptoms of a septic infection associated with local manifestations referred to the heel. The general symptoms vary greatly in their intensity. In the early stages a sudden onset with a marked chill, high temperature, rapid pulse-rate and evidences of profound intoxication may be associated with moderate pain and tenderness only with deep and continuous pressure over the heel; while the local pain and tenderness may be marked and the general symptoms comparatively mild in the cases in which the infection is less virulent.

For practical purposes the symptoms of osteomyelitis of the os calcis may be divided into two classes: (1) those complicating wounds of the heel, and (2) those in which the heel has not been injured. In the cases unassociated with wounds, the os calcis may be involved alone, or multiple osteomyelitis may be present. Lebecq reports the case of a man who had pain in the heel and later developed septic symptoms. There was no swelling, oedema or redness over the os calcis. No wound was present; neither was there a history of injury. After being septic about 9 weeks the patient died. Shortly before death an abscess developed in the heel but it was not drained. Postmortem showed osteomyelitis of the os calcis with a sequestrum as the cause of the sepsis. In this class of cases it is to be expected that pain would be marked in the early stages; that swelling, redness and superficial tenderness would occur only after the inflammatory process had extended from the bone to the soft structures; that the formation of a communication between the bone-marrow and the soft structures would markedly diminish the pain; and that spontaneous drainage to the surface would relieve both the local and general symptoms.

Owen reports a case of osteomyelitis in which the ulna, tibia and os calcis were simultaneously involved. In cases of multiple septic osteomyelitis it is well to keep in mind that the os calcis may become involved; and, as Kirmissen has said, osteomyelitis may affect any bone in the body.

In the cases of osteomyelitis of the os calcis following wounds there is a disproportion between the general septic symptoms with pain in the heel and the local swelling with superficial tenderness. The pain may be intense and the toxæmia marked while the tenderness and swelling are slight. Such a condition progresses in severity until artificial or spontaneous drainage is secured. Then the local and general symptoms suddenly improve markedly and a discharging sinus remains. Vincent says that 5 per cent. of these cases die if untreated or if proper surgical treatment is unduly delayed. It is probable that osteomyelitis of the os calcis, like osteomyelitis in other bones, may occur in all degrees of severity. Schinzinger says that the affection may be so mild that it does not result in necrosis.

Diagnosis.—What has been said regarding symptomatology indicates the factors that speak for or against the presence of osteomyelitis of the os calcis. If the condition has at times been overlooked, I believe it has been because it was not thought of rather than from inability to recognize it from the signs and symptoms obtainable. Septic or rheumatic involvements of the ankle-joint result in more diffuse swelling, and the anterior ligaments of the ankle are tender and present a fulness not found in disease of the os calcis. Movement of the joint increases the pain in diseases of the ankle, while this is not the case in osteomyelitis of the heel. Tuberculosis of the ankle-joint, or tarsal bones, may present difficulties in diagnosis. Tuberculosis is, as a rule, less intense at the beginning; it results in more atrophy and contracture of the muscles of the leg, and may be associated with general symptoms and findings that plainly indicate tuberculosis. The greatest difficulty in making a diagnosis of osteomyelitis of the os calcis is presented when diffuse acute infection complicates wounds in

the region of the heel. In these cases it may be impossible to tell whether the bone is, or is not, involved. If the changes in the soft parts are marked, and the general symptoms slight, the bone is probably not diseased. If the local and general symptoms are severe, and there is no drainage, the bone is likely to be healthy. But with free drainage from the soft parts, associated with marked general symptoms, the bone may be expected to be involved. If no drainage is present and a diagnosis cannot be made, incision of the soft parts should be first done and if this is not followed by marked relief the bone should be explored without delay. In the chronic cases, with sinus-formation and persistent discharge, the diagnosis is all but positive. The X-ray may be of value in recognizing this condition.

Treatment.—Osteomyelitis of the os calcis is a surgical disease; and its treatment should be operative. In the acute cases, the operation should be done early and should consist of drainage into the bone-structure. In the chronic cases all necrosed and diseased osseous tissue should be removed, leaving the periosteal shell. If the tendo Achillis has not already become separated from the calcaneum,—as it was in Senn's case and in one of my cases,—it should be lengthened and the foot dressed at a right angle. The bone-cavity should be packed or filled with a Mosetig-Moorhof plug. Although circumstances prevented the use of the plug in the cases here-with reported, it would seem to be indicated in operations for the chronic forms of this disease.

Operative Treatment.—So-called excision of the os calcis has received considerable attention. Sédillot's subperiosteal method is recommended by Holmes, Erichsen, Southam, Vincent, Ollier and others. The method of exposing the bone should be governed by the position and number of the sinuses in the soft parts. The inner or outer lateral straight or curved incisions are ample. Ollier made a lateral flap. Erichsen used an elliptic plantar flap. Holmes, Southam, Lund and others recommended various side incisions. It is sufficient to say that in these operations all necrotic bone should be removed and the periosteum left.

FIG. 1.



Osteomyelitis of *os calcis*. Photograph of foot in Case III.

FIG. 2.



X-ray of foot in Case III.

CASES.

SENN reports one case of osteomyelitis of the os calcis occurring in a "little boy." Subperiosteal resection was done and the tendo Achillis detached. More than one half of the bone was reproduced at the end of two months. The patient walking without the use of a cane or crutch. Previous wounds or injury are not mentioned.

FERGUSSON (Lancet, 1874, i, 10) reports one chronic case of osteomyelitis of the os calcis with sinus formation and sequestration. The sequestrum was removed and the patient recovered. The report is very brief and incomplete.

ZWICKE (Charité-Annalen, 1881, viii, 478) merely describes a central necrosis of the os calcis in a boy 12 years of age. The bone contained a cavity the size of a hazel-nut filled with a fungous growth. Two operations were required to effect a healing.

OWEN (Lancet, 1897, i, 37) reports a case of a boy 7 years old who had suffered for two years with osteomyelitis of the radius, ulna, tibia and os calcis. Multiple bones were operated upon. The os calcis was curetted and found to contain a pea-sized sequestrum. The boy improved rapidly but was still in the hospital two weeks after the operation had been performed.

LEBECQ (Bull. de la Soc. Anatom. de Paris, 1887, iii, 55) reports a case of osteomyelitis of the os calcis occurring, without injury, in a man 44 years old. In this case chronic pain in the heel became acute, septic symptoms developed and resulted in death. An abscess formed over the os calcis but it was not drained. Postmortem revealed pus and a sequestrum in the os calcis.

SCHINZINGER¹ reports 4 cases of chronic osteomyelitis of the os calcis. "Some had a history of an injury;" in all sinuses and sequestra were present. Subperiosteal resection resulted in a cure in each case.

CASES OBSERVED BY AUTHOR.

CASE I.—During the summer of 1902, Carl J., of Montrose, Colo., jumped on a rock, cutting his left heel. About one week later he was suffering from pain in the heel and fever. There was marked swelling, and a discharge of pus from the wound. The local and general symptoms increased in severity for 10 days, then the pain became less and an abscess developed on the inner side of the heel. This was incised. Marked relief followed. I saw the boy two months later. His general condition was fairly good: temperature normal. Two discharging sinuses were present on the inner side of the heel. These were connected by an incision, the two openings in the bone enlarged, two pea-sized sequestra extracted, and necrotic osseous tissue removed with

a curette. The wound was packed, the tendo Achillis divided in sections, and the foot dressed at a right angle to the leg. In three months the wound had healed and the boy could walk. Two years later the foot was apparently normal except for the presence of the superficial scars.

CASE II.—In 1905, a boy of 8 years stepped on a nail, wounding the right heel. At the end of three weeks his temperature was 103, and the heel painful and swollen. The family physician made a liberal incision over the inner side of the os calcis, evacuating pus. Two months later a sinus was present, extending into the bone. The os calcis was necrotic but no sequestrum was found. The dead bone was removed with a curette, the wound packed, and the foot dressed at a right angle to the leg. The wound healed in four months. One year later the foot was functionally normal.

CASE III.—Frank G., aged 11, in August, 1907, cut his right heel by stepping on a piece of glass. Infection followed, and superficial incisions were made. An abscess opened spontaneously in September, 1907, but the heel remained painful, tender and swollen. Operation was done November 15, 1907. Only a shell of the os calcis remained. Two large sequestra were removed. During the operation the tendo Achillis tore away part of the posterior periosteum of the calcaneum. The bone-cavity was packed, and the foot dressed in the proper position. In five months the healing seemed complete. On June 5, 1908, the foot is functionally normal, and the deformity not marked. The photographs are of this case.

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SILVERIZED CATGUT—THE ARGYROL METHOD.

THE USE OF ARGYROL IN ITS PREPARATION.

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DURING the last eighteen months, following a visit to the clinic of Crédé, in Dresden, I have used catgut which I have prepared with a ten per cent. solution of argyrol. The method is as follows:

Catgut is purchased in the ordinary five yard length; it is then cut into strands eighteen inches long; these lengths are then placed in a basin of sterile water to slightly soften the gut and make it more easy to handle.

The gut may be made into little coils by winding around the first two fingers; the last one inch being twisted around the little coils to hold them together. This is not recommended as the gut is liable to snarl.

Three-eighths glass tubing may be cut into one-inch lengths, the ends being carefully annealed. The gut may be wound around these little tubes so that the first lap or two will hold the starting-point firmly, and the last end can be held by a half-hitch around the tube (I use the tube instead of the rod in order to have less weight and allow the solution to circulate more freely in the receptacle or jar containing the gut under preparation).

The gut is now soaked in the ten per cent. solution of argyrol made up with distilled water, for ten days. I have used one-quart jars, having wide mouth and ground-glass stoppers.

After labelling the jar with the size of the gut and the date on which the process is started, it is my custom to envelop it in a sterile towel, pinned to hold it in place, and to protect it from the dust and strong light. Each day the jar is agitated

slightly in order to keep the argyrol more completely in solution.

At the end of ten days the jar is gently shaken each hour for several hours previous to the time planned to take the gut out of the solution, in order to mix well any portion that may have settled on the tubes of gut or at the bottom of jar. A piece of sterile gauze is placed over the mouth of bottle, the bottle turned upside down over a sterile funnel in order to keep the tube from coming out and to save the solution that it may be returned to the stock receptacle for future use. An irrigator filled with sterile water, or sterile glass tube, is used to wash the gut in order to free it of any superfluous argyrol solution. This is done by letting into the jar some of the sterile water, shaking the jar gently in order not to detach the gut from the tubes. This process is repeated several times until the wash-water comes away clear.

The gut is then stored in pure alcohol where it can be kept indefinitely. The alcohol tightens the gut on the tube so that it is not easily detached although it is easily removed from the tube when you wish to use it. The gut is now ready for use after an hour or two in the alcohol.

In October, 1907, Dr. Charles T. McClintock, Director of the Biological Department of Parke, Davis and Company, examined several samples of this gut and found it to be sterile. Practical experience has demonstrated its sterility.

It is my opinion that catgut prepared with argyrol is an ideal gut and is not only thoroughly aseptic but is antiseptic and has the tenacity of the original gut. I have used it in various kinds of surgical cases, have used it in many abdominal operations; have used it almost universally in closing deep wounds layer by layer, and it has been especially satisfactory as a skin suture using the number "0" or the number "1."

Its use as a skin-suture has been not less satisfactory than has been my experience during the past several months in its use as a buried suture; the results from its use have been practically perfect; better to my mind than any other suture material.

The advantage of the argyrol solution over the collargolum¹ is that it does not precipitate so readily, and its power to penetrate into the centre of the strand is greater. It cannot be said that its aseptic qualities are any greater than that prepared with collargolum although I like its practical application better and when used for skin suture I believe it is much more satisfactory.

From my experience with the various methods of preparing catgut, I believe the argyrol method is entirely practical, is extremely satisfactory, and is recommended for its simplicity.

NOTE.—In a communication received from Professor Crédé, dated February 22, 1908, he states that he now prefers to prepare silver catgut with silver lactate, actol, which he considers to be easier to prepare, more stable, and more antiseptic. His technic is as follows:

Raw catgut, just as it is received from the manufacturer, is wound on a glass reel and submerged in a one (1) per cent. solution of actol, in which it is left for one week; the glass jar in which it is placed being wrapped with cardboard to keep out the light. After eight (8) days, the solution is poured off, the open jar covered with four (4) thicknesses of gauze, and exposed to the light until the strands have turned black; distilled water is then repeatedly poured over the catgut in the jar until the water remains clear. The jar is again covered with four thicknesses of gauze and stood in a warm place until it is thoroughly dried out; then it is closed with a cover, for it is ready for use, not having been touched with the fingers during the process of preparation. Before using, a reel is placed in a dish containing 60 per cent. alcohol, out of which it is used during operation. Strong alcohol makes it too stiff and less firm.

¹ Blake, *Annals of Surgery*, 1907, *xlv*, 110.

SURGICAL PROGRESS.*

GENERAL SURGERY, PATHOLOGY AND THERAPY.

I. Operative Interference in Embolism of the Pulmonary Artery.

F. TRENDELENBURG, of Leipzig, said the first thing to be considered was whether those conditions could be fulfilled, with regard to operative interference in cases of emboli of the pulmonary artery, which would justify the application of surgery; that is to say, whether the diagnosis of embolism can be ascertained with sufficient accuracy and whether there is sufficient time for an operation.

The first question, he concludes, can be answered in the affirmative, although, individually, the symptomatology is complex, in their entirety they give a certain characteristic picture; usually the well-known symptom-complex of sudden collapse, pallor, lividity of the lips, loss of pulse, together with deep and distressed respiration. Generally the diagnosis will be strengthened by minor indications, either through a previous operation in which the larger veins were exposed or ligated, or because of an evident thrombosis of the femoral or other veins, or by fracture of one of the lower extremities, or by varicosities. Auscultation of the heart generally gives a negative result; systolic, or systolic and diastolic murmurs may be interpreted as an evidence of the fact that the embolism is in the right heart.

With regard to the second question, he states that death by no means results as suddenly as is generally supposed. In reviewing nine cases of embolism occurring in the Leipzig Hospital, he found that only two succumbed very suddenly,—in from one to two minutes. In the other seven cases, an interval

* Excerpts from the Transactions of the GERMAN CONGRESS OF SURGERY, held April 21 to 24, 1908. Translated by JAMES TAFT PILCHER, M.D., and WOLFGANG JOERG, of Brooklyn, N. Y., from the abstracts published in the Beilage zum Zentralblatt für Chirurgie, No. xxxv, 1908.

varying from ten minutes to an hour elapsed before the patients died; with at least one-half of the cases it was found that as much as fifteen minutes would have been at the disposal of the operator, that is to say, enough time for an operation in a hospital.

The technic of the operation was demonstrated on a corpse, and corresponds to the technic given in the *Zentralblatt* No. LV, 1908. Briefly stated, the facts are that the pulmonary artery lies in the second left intercostal space and is covered by the pericardium, and behind it lies the superior vena cava. Experimentally, he has established the facts that complete compression of the pulmonary artery can only be tolerated, at the longest, forty-five seconds to two minutes, beyond that, death occurs. Partial compression, is possible, for several minutes. Compression of the superior vena cava can be borne for at least ten minutes, according to Sauerbruch. Presumably the venous plexus of the heart supplies the right heart and the lesser circulation with blood when the vena cava is compressed; while, on the other hand, when the pulmonary artery is compressed, all blood is cut off from the lungs. Simultaneous compression of the pulmonary artery and aorta has the same effect as that produced by compression of the pulmonary artery alone.

It is, therefore, necessary that the emboli be extracted as soon as possible after the compression and incision of the pulmonary artery; forty-five seconds should suffice for such a simple procedure. There is, however, no objection to compressing the artery laterally if one needs more time, then to release the pressure and allow the circulation to be resumed; then recompress, and continue the search for the branches of the pulmonary artery which contain the emboli.

A transverse incision on the second rib, and a vertical incision on the left side of the sternum, are to be preferred to the flap incision for opening the thorax. The part of the second rib adjacent to the sternum is resected for 10 to 12 cm., a vertical incision is made through the pleura and into the pericardium at the level of the third rib. The vessels here lie a little underneath the sternum, they are pulled forward and a rubber tube is passed behind the aorta and the pulmonary artery, and afterwards drawn upon. After this procedure rapidity is essential; incise the pulmonary artery, pull out the embolus with a pair of forceps, and

immediately close the incision in the arterial wall with clamps, and, as before stated, using no more than forty-five seconds. The compression is then removed, and one can suture the artery and the soft parts at leisure.

Trendelenburg, in referring to a previously published article—in reference to a calf which was killed four months after the removal of an embolus 15 cm. long from its pulmonary artery—showed the specimen of the heart; on the inner side of the pulmonary artery the place of the incision could be easily recognized by a thickening and callousness on the intima; the silk threads which were included could not be discovered from the outside as they had been covered over by hyperplastic tissue. An attempt to apply this operation to a man seventy years of age was not successful, owing to death on the table. Since then he reports two cases which had been operated on in the surgical clinic at Leipzig (*Deutsche Zeitschrift für Chirurgie*, vol. xciii., p. 282; and *Deutsche Wochenschrift*, No. xxvii, 1908) both of which cases proved the feasibility of this operation on man. The two patients, who had become pulseless during the operation, revived quickly after the extraction of the pieces of thrombus from the pulmonary artery, some of which were 34 cm. in length; the loss of blood from the artery itself was very small. The first patient, however, died fifteen hours after the operation from heart failure. The second patient, also, died from a post-operative hemorrhage from the internal mammary artery, but survived his operation for thirty-seven hours. In a branch of the pulmonary artery an overlooked embolus was found, post mortem.

II. Shortening the Treatment of Patients Subjected to Laparotomy, by Allowing Them out of Bed Early.

KÜMPELL, of Hamburg, after a historical review of the methods heretofore used, pertinent to allowing persons who have undergone operations, particularly those who have been subjected to laparotomy, to leave their beds earlier than is customary, discusses his experiences.

Since January, 1908, he has observed 164 patients who had left their beds on the first to the third day after the operation: of these there were fifty herniotomies; eight Alexander Adams's; fifty-six appendectomies à froid; twenty appendectomies à

chaud; seven extirpations of ovarian cysts; four myomectomies; salpingectomies (pyo-salpinx, ectopic gestations); three cholecystectomies; four entero-anastomoses; gastro-enterostomies, and exploratory incisions. The reason for diverging from the previous methods of having persons after being subjected to laparotomy keep to their beds for two to three weeks, was the experience of others that the chances of emboli are considerably diminished when as normal a condition as possible is brought about by having patients sit up as soon as possible after the operation, and allowing the action of the heart and other organs to correspond as nearly as possible to normal conditions. As a matter of fact, the experience of operators in this domain has demonstrated a considerable diminution of embolic and thrombic sequelæ.

Among the 164 cases which Kümmell considers, there is only one unimportant thrombosis and no embolic occurrences; while according to the old method, in the year 1906-7, with almost the same number of laparotomies, that is, 600, about one per cent. of these died from the effects of thrombosis and embolism. The author sees an advantage in the new method that is not to be underestimated, viz., that the wounds heal more firmly than might usually be expected.

As a pre-requisite to the application of this method, Kümmell designates:

1. Perfect anaesthesia, without vomiting or other complications.
2. Quick operation; small loss of blood.
3. Primary union.
4. Firm suture of the fascial planes.

In this case, as in every other one of such eminent importance, judgment must be used, and adherence to one procedure for everything avoided. And here the valuation of the idiosyncrasies of the patient must be taken into consideration. He has not recorded, so far, any failures by this method, on the contrary, it has proved itself efficacious (*a*) in that it diminishes the symptoms of disturbed intestinal activity which are so often disagreeable after laparotomy; (*b*) in that the subjective condition of the patient is ameliorated; (*c*) in that it promotes the recuperative powers; briefly, then, that it shortens the length of convalescence, and, above all, leads to a firmer cicatrization.

III. The Spark Treatment of Cancer.

V. CZERNY, of Heidelberg, remarks that four-fifths of his patients are suffering from inoperable carcinoma. For this reason the method of treatment as suggested by Keating Hart was used as a last resort. The apparatus can be joined to the Röntgen coils, of which one uses the inductor and Wehnelt current interrupter. The electricity is conducted to a petroleum condenser which is fitted with spark and solenoid interrupters; the latter being in connection with the Oudin resonator; a copper spiral of 130 turns which by means of a lever controller, is so attuned to the solenoid that from its upper pole through a metal electrode, sheafs of sparks of 10 to 20 cm. in length will be emitted. These sheafs of sparks, which are cooled in a stream of carbon dioxide or compressed air, are directed from five to forty minutes on the carcinoma and its vicinity in various directions, while the patient is in deep narcosis.

Then the carcinoma is extirpated or curetted, the hard border cut off with a knife, and the surface again subjected to the sparks for ten to fifteen minutes, in order to destroy the remaining carcinomatous nests. The action of the spark discharges seems to cause a destruction of the carcinoma cells and also of the intervening tissue if it is soft; tough scirrhus tissue or healthy skin resists long exposure, but are eventually changed to a burnt scab.

Deep-seated carcinomas are best extirpated by the usual surgical procedures, and the surface then subjected to the sparks. Especially when the first operation is for recurrence, or if the condition of the tumor makes recurrence likely. There is a good deal of subsequent secretion from the surfaces so treated, and the parts must be well drained or treated openly with tampons.

Czerny reports from November, 1907, to April, 1908, 120 such treatments. The fulgurations were used on fifty-nine patients; of these, four were sarcomas, in which one may naturally expect better results than in carcinoma; the results of the latter can not as yet, of course, be permanently stated. But of these cases several are improving; seventeen have died; eight facial carcinomas have been cured; some have had relapses into their former condition after short periods of improvement. The treatment seems to be most useful in the superficially ulcerated, and

particularly in the soft carcinomas. It stimulates rapid cicatrization and granulation, and is certainly more efficacious than the Röntgen ray or radium, although they should not be neglected as accessories.

IV. Remarks Concerning the Technic of Transplanting the Thyroid Gland.

KOCHER, of Bern, reports on several successful cases of attempts to graft thyroid tissue onto bone (the tibia), a process which obtains just as certain results and is simpler and less dangerous of execution than, for instance, the former procedure of transplanting into the spleen.

In discussion of the above paper, Payr, of Greifswald, states the further course of the case of thyroid transplantation into the spleen, referred to two years ago in the Surgical Congress. Since the operation, twenty-eight months have passed, a period which suffices to allow formation of a judgment on the result of the transplantation into that organ.

It had been a very unfavorable case, in which the speaker had transplanted a large piece of maternal gland into the spleen; the child had for three years previously been treated internally with various thyroid preparations, with little success. In spite of the lack of results in this former treatment, after the transplantation, the intellectual and somatic condition of the child had improved in a remarkable degree during the first months and to the end of the first year; after that, somewhat more slowly. With regard to the intellectual condition of the patient, Payr reports that the child was totally imbecile and animal-like in its entire disposition; it could neither stand, walk nor sit, it emitted inarticulate sounds and did not react to sensory impressions. All these symptoms improved remarkably. Growth and increase of weight were very evident. The X-rays were not used to observe the epiphyseal growth, on account of the injurious effect which they have on young bones. The child, since the fall of 1907, has not progressed much and has suffered repeatedly from intense catarrhal conditions; it has become very anemic and sallow and has developed a general glandular enlargement, including the spleen. The increase in weight has also dropped off, but the child now weighs 19,400 grammes (average weight of a child of eight years); the dentition, growth of hair, and nail develop-

ment are all normal, and the skin shows no evidence of the former myxodermatic changes. The position and carriage are not absolutely straight and the gait, in the last two months, has become spastic.

The later results have not come up to the promise given by the improvement in the earlier months; it is certain, however, that the child has shown no recurrence of its myxoedema, and we must deduce, therefore, that the gland transplantation is still in a viable condition. There were also many factors gravitating against the best interests of the child; that is, poor lodging, poor nourishment, bad air, light and care; the result, therefore, can not be considered a complete one. With our present-day knowledge it is probably of prime importance in which kind of case of hypothyreosis operation is performed; whether it be a case of congenital or acquired myxoedema, or cachexia strumipriva, or, finally, of a combination of cretinism with myxoedema. We know from the recent investigations of Scholz and Zingerle that in cases of cretinism important changes are evidenced in the central nervous system, especially in the cerebrum, and these are present in almost every case. In the combined cases of congenital myxedema and cretinism, particularly in cases of somewhat older children, the chances of success of transplantation are, therefore, probably, very limited, because it seems doubtful if the cerebral defects caused by the lack of thyroid extract are capable of being reconstructed. The more recent the case, the better the success.

With reference to the technic, the spleen is especially adapted to receive the transplantation because of its highly developed vascularization. If it become evident that the marrow takes care of the nourishment of the transplanted tissue in the same way, then of course this method would prove much simpler and less dangerous.

GARRÉ (Bonn) transplanted, in a case of chronic tetany after goitre extirpation, a parathyroid which he had removed from a case of Basedow's, into the tibia, with marked improvement in the symptoms, but suggests that we should transplant entire organs by means of the vascular suture (Stich), if permanent results are to be obtained. This has been accomplished experimentally.

CZERNY (Heidelberg) extirpated an entire carcinomatous gland, and transplanted for the resultant tetany a fresh piece of gland in the spleen, with immediate improvement of the symp-

toms. On autopsy, death having occurred from pneumonia on the sixth day, the thyroid implantation was found to be perfectly healed into the gland substance.

MULLER (Rostock), in two cases of cretinism, has made transplantations into the tibia, with marked intellectual improvement. Eiselsberg also reports two successful cases by this method, which had resisted all other procedure; and one other, in which he had not been successful because of suppuration.

V. Use of Free Bone Plastic and Attempts at Bone Transplantation.

LEXER, of Königsberg, i. Pr., reports on his experiences with free bone transplantation based on many cases. Those treated consist of replacing large gaps in the skull, of lifting sunken portions of the facial skeleton, replacing large defects in the long bones and the lower maxilla, cure of pseudo-arthrosis including cases of neck of the femur, the bolting of bones, the stiffening of paralytic joints especially in the foot, of bolting adjacent bones including the head of a joint or including both epiphyses, and, finally, the transplantation of entire joints. Formerly he used boiled and macerated bone and transplanted it underneath the periosteum; this was successful in small defects but not in large ones, the bone being usually extruded by suppuration.

In the cases now considered, he has been using material gathered from the abundant amputations of his clinic, for transplantations. For this purpose he finds the fresh bone covered with periosteum best suited, while the old process served in most instances only where the bone had been transplanted under the periosteum into the bone itself in the case of large pieces to replace defects in the long bones. As the marrow in the transplanted bone causes an inflammatory action accompanied by fever resultant from its destruction, he now clears this out and fills in the cavity with iodoform, by which means this inflammatory phenomenon of resorption has been obviated. The gradual absorption of the filling is easily checked up by means of the X-ray and thus the continuation of the vascularization observed.

Of interest in his report is a case in which for sarcoma of the upper third of the tibia, a transplantation was made to supply the defect caused by amputation including one-third of the bone

together with its articular surface. The result healed in and a relatively good functional joint was obtained. A similar case is noted in the resection of the upper end of the humerus.

Again, in a case of bony ankylosis of the knee, he substituted, after a section of the joint, an entire fresh knee-joint with cartilages and crucial ligaments, measuring from one to one-and-a-half cms. on either side of the joint's surface. Seven months after the operation he reports that slight movement has resulted, and remarks that it was problematical whether good movement could ever be obtained.

VI. A New Method for Local Anæsthesia in the Extremities.

A. BIER (Berlin) suggests that in order to perform operations on limbs which have heretofore been impossible to do without pain, under local anæsthesia, that the part to be anæsthetized should be isolated between two rubber bandages, one above and one below the part to be operated on, and should be spread over as large an area as possible without encroaching on the field. This is painless in contradistinction to the ordinary Esmarch operation. In the isolated part a vein is then picked up as close as possible to the proximal bandage; in the leg, the saphenous; in the arm, the cephalic, basilic or median. For the fore-arm the large superficial veins may be used. The procedure subsequently is similar to that used for an infusion; he injects between fifty and eighty c.c. of a 0.25 per cent. or 0.5 per cent. novocain. The part immediately becomes anæsthetic if the technic has been successful.

The anæsthesia is to be divided into two parts; first, the direct and immediate anæsthesia; and, second, the later or indirect anæsthesia, viz., one which occurs below the distal bandage; the operation should be done in the first stage. Soon after the second stage motor paralysis will be evidenced. Under this procedure the author has painlessly resected elbow and knee joints, done various amputations, sequestrotomies, and tendon implantations. Poisoning is avoided because of the artificial anæmia produced, and owing to the constriction the novocain does not get into the circulation, and also because of its dilute solution. It is further obviated by first loosening the proximal bandage lightly to allow a primary circulation of the

arterial blood, the venous returns still in check, in order that the wound may so be washed out. The bandage is then tightened and is not loosened again until the end of the operation. Finally, the vein may be washed out through the cannula, with a physiological salt solution. The anæsthesia disappears immediately on loosening the proximal bandage.

HEAD.

I. The Operative Cure of Acromegaly by Removal of a Hypophysial Tumor.

J. HOCHENEGG (Wien) reports the case of a patient thirty years old, in whom, on account of the very evident symptoms in conjunction with a Röntgen ray photograph of the skull, a diagnosis of acromegaly and tumor of the hypophysis was made. The acromegalic changes involved the head, face, hands and feet; the superior incisors were separated about half an inch; the disease itself seeming to have developed in two distinct parts. The patient remained normal up to the fifteenth year; between the ages of fifteen and twenty-five she became pale, suffered from intense headache, periodic attacks of perspiration, nose-bleed and cessation of menses. There soon developed a defect in the sight. After one year these symptoms disappeared, the menses returned and continued for four years, when they again became scanty in August, 1907; the headache returned, and under parasthesia, enlargement of the hands and feet developed together with marked thickening of the lips, nose and tongue. The changes in the general disposition of the patient became so evident as to be easily recognized by her friends. The method used consisted in turning back the nose and reaming out the entire nasal cavity, until the apex of the cone so formed was situated at the bed of the hypophysis, after the method of Eiselsberg, Schlofer and Tandler.

The case further demonstrated that in acromegalic conditions the sinuses of the face, especially the frontal sinus, are very much enlarged, thus giving more room superiorly, if it be opened and cleared out in the course of the operation. On account of the subsequent defect in the anterior wall, two incisions were made in the line of the eyebrows, the bone chiselled through and then fractured, but not removed. The pharynx was tamponed in the

posterior nares, the wall of the sinus of Highmore and the internal orbital plate were left intact, the hemorrhage checked by tampons of adrenalin. On the final chiselling through of the sella turcica, a tumor—white and tense, the size of a hazel-nut—appeared at the apex of the cone; the dura was split, and the real tumor which then appeared soft and reddish-brown, swelled out into the wound under pulsation.

The growth was curetted until only the tough dura lining the cavity was felt; the cavity was then wiped out with adrenalin tampons. This was all done through an aperture about the size of a pea; this is a very good procedure as the danger of subsequent meningitis is minimized. The cavity was lightly tamponed with an iodoform wick, and iodoform gauze was gently packed into the nasal cavity through which the iodoform wick was led. The post-operative course was easy and free from complication. The drains were removed on the eighth day, and on the tenth day the patient was allowed up. Pathological diagnosis, adenoma of hypophysis.

The results are to be viewed from two separate aspects:

1. The headache stopped; the psychic condition immediately improved; the eyesight was much better. These three considerations can be looked at as the result of mechanical pressure; similar effects have also been obtained by other operators.

2. The greatest result, and the most remarkable, was the effect on the acromegalic condition; five days, post-operative, the patient subjectively remarked that the incisor teeth were approaching each other, that her jaws set differently; on the tenth day this change was very marked, and the hands were markedly diminished in size. One month later the patient was discharged. The foregoing signs had continued to improve, her feet had become greatly reduced in size, and her entire appearance was so changed that she was unrecognizable.

The divergent views on the importance and relation of hypophysial tumors with regard to their effect on the symptom-complex of acromegaly are interesting.

I. Hypophysial tumor is a partial phase of acromegaly, and is only one of the evidences of general enlargement.

II. Hypophysial tumor is the cause of the acromegaly, through the cessation of function of the hypophysis, or through

the increased function of the hypophysis, or through the qualitatively changed secretion.

III. Hypophysial changes have a causal importance, but only for changes within the region of the head as being the part of the body connected with the cranial nerves.

The author's case, which he states is the first in which the operation was successful, may decide the question in particular, which influences are to be ascribed to hypophysial tumor in the genesis of acromegaly. The operation, however, viewed in the light of nothing but an experiment, seems to prove conclusively that hypophysial tumors have not only symptomatic but also etiological importance. It also proves that the acromegalic phenomena are caused not by a cessation of the hypophysial function but by a hyperfunction of the cerebral appendage, and proves further that the changes in the extremities are due absolutely to the hypophysial secretion.

H. BORCHARDT (Berlin) demonstrated a young man operated upon two months before for tumor of the hypophysis, exhibiting the symptoms of violent headache and visual disorders. The operation was done primarily through the frontal sinus, but while on lifting the frontal lobes the hypophysis could be reached, it was inaccessible to operation, and was accompanied by an alarming hemorrhage. A secondary operation was done through the nose and a partial resection of the tumor was accomplished, with the result that the headaches have stopped, and the maniacal attacks from which the patient had occasionally suffered have been relieved.

VON EISELSBERG (Wien) reports three cases operated on in January, 1907. The first case was a man twenty years old, who was operated on for a symptom-complex of headache, double hemianopsia temporalis, adiposity and defective development of the genitals. The X-ray gave a shadow of a tumor of the hypophysis. Operation, January 21, showed a cyst in the situation of the hypophysis, the pathological examination of which indicated an epithelial carcinoma. Result; the headache ceased, visual disorders were diminished, tendency toward corpulency inhibited, and at present the patient feels perfectly well.

The second case was a patient thirty-three years old; typical acromegaly. Eight years ago, while pregnant, noticed enlargement of hands, feet and face; had previously suffered

from headache and visual disturbances. X-ray showed a considerable enlargement of the sella turcica, in addition to which there was considerable enlargement of the lymphatic glands, and a chronic catarrh of the posterior nares and pharynx, because of which latter fact no operation was done. Later, however, the patient insisted that she be operated upon; this was done and a solid tumor removed. Two days later death ensued from meningitis. Autopsy disclosed a large basal tumor extending far under the frontal lobes. Pathological diagnosis, sarcoma.

The third case was a man twenty-six years old. For two years he had suffered from intense headaches, visual disorder and vertigo. Examination of the eyes gave a left hemianopsia and an atrophy of the right optic nerve. X-ray showed enlargement of the sella turcica. On operation, the tumor was removed by the usual nasal route, with the result that the headaches were stopped, and subsequent improvement of the optic conditions ensued. Diagnosis, sarcoma.

Referring to operative technic, Eiselsberg used the nasal flap approach with removal of the wall of the frontal sinus, but thinks that Hochenegg's idea would prevent the subsequent deformity, and states that the operation is certainly feasible, especially where the tumor is of a benign character. Care should be taken that the presence of diabetes is eliminated before operation on the tumor, as these two conditions are often dependent upon each other.

THE THORAX.

I. Intra-Thoracic Operations in Positive and Negative Atmospheric Pressure.

H. KÜTTNER (Breslau) reports his experience during the past year in eighteen cases operated on according to the methods of Sauerbruch and Brauer. In nine cases he used the former's method of positive pressure, and in the other nine cases he employed the latter's apparatus for effecting negative pressure. The cases consisted of gunshot wounds, tumors of the chest wall, bronchiectasis, lung fistula, two primary lung cancers, and three carcinomas of the thoracic portion of the oesophagus. In all the cases the author decides that the methods independently of each other, may be employed to a very decided advantage, and tend to show a marked progression in the surgery of this region.

Considered physiologically, both methods seem to have an equal value, but he considers that of Sauerbruch much the more convenient, on account of the increased facilities which it offers to the operator.

ABDOMEN.

I. Gastro-Duodenoscopy and Diaphanoscopy.

TH. ROVSING (Copenhagen) presents this method as an aid in a large number of those cases where the surgeon during the operation, after he has the stomach under direct vision and after thorough inspection and palpation, has not come to any definite diagnosis. The gastroscope is introduced into the stomach through an incision 1 cm. in length on the anterior surface; it is inserted just above the greater curvature and approximately midway between the pylorus and the fundus. It consists of practically a greatly enlarged Nitze gastroscope, but with an apparatus through which air can be introduced for subsequent dilatation. The cut is made small enough so that the instrument, after its introduction, will render the stomach airtight after the application of a purse-string suture around its shank. The procedure consists now of two parts:

First, the diaphanoscopy, and second, the direct gastroscopy. Considering, then, diaphanoscopy: The lamp is lighted as soon as the stomach is sufficiently inflated, the distal end is then moved slowly and methodically over the entire stomach area, on which all the anatomical details of the walls have become astonishingly sharp and distinct; the blood-vessels, the course of the muscle-fibres in the different localities, etc. In order to procure the best results from the illumination it is found best to hold the lamp in the middle of the stomach and to observe its conditions in a perfectly dark or semi-dark operating-room. One can recognize very easily a gastritis from the strong red to deep bluish-red color of the walls, and also by the thickened and distended vascular net-work. Tumors are recognized by the dark, diffuse shadow on the otherwise clear stomach wall. In sharp contrast to this condition, one sees the deep chronic ulcer in the centre of a white, porcelain-like vascular-free portion which is contrasted sharply by a dark red zone. Small erosions or superficial ulcerations of the mucous membrane, if they are bloody or covered with a blood-clot, appear as dark spots on the wall, from which

a blood stream may be seen flowing in a dark streak down towards the greater curvature. After the examination of the stomach, the operator may pass the instrument through the pylorus and into the duodenum which is very brilliantly illuminated because of its thinner wall and because of the greater concentration of the illumination.

Second, gastro-duodenoscopy: When one has noticed by diaphanoscopy any abnormal place on the wall of the stomach, this he can then verify by looking through the gastroscope, and so appreciate the exact condition which exists; and in a few minutes he can examine the entire stomach mucous membrane from the cardia to the pylorus, and, further, the pylorus and the duodenum as far as the papilla, when no advanced pyloric stenosis interferes with the passage of the instrument. No abnormality can be concealed on the stretched mucous membrane.

In two cases where from the clinical picture the diagnosis could not be made between carcinoma and ulcer, on examination with this instrument the stomach was found perfectly normal, but severe ptosis was observed and a subsequent gastropexy proved that this was the cause of the symptoms and suffering. In nine cases, ulcers of the stomach were unexpectedly found; in three cases, ulcers of the duodenum were determined as having caused symptoms which were insufficient to determine the exact diagnosis; and in four cases, malignant growths were discovered. In one very important case a patient was undoubtedly saved, from a very severe hemorrhage caused by a very small erosion, which bleeding-place was discovered without danger through the method of diaphanoscopy.

The author also mentioned a specially constructed gastroscope which he used for retrograde introduction into and dilatation of the œsophagus, in cases of stricture which had been found impermeable from above.

The apparatus is easily disinfected by being placed for thirty-six hours in a formalin sterilizer.

In none of the twenty-five cases did peritonitis develop, and only two of the patients—who had advanced cancers—died, of pulmonary complications.

TRANSACTIONS
OF THE
PHILADELPHIA ACADEMY OF SURGERY.

Stated meeting held June 1, 1908.

FIBROLIPOMA OF SYNOVIAL FOLDS OF KNEE-JOINT.

DR. JAMES K. YOUNG presented a man, 21 years of age, who five years ago sustained an injury to the left knee from a fall on the ice. He exhibited the usual symptoms of synovitis, of which pain was an important and persistent feature, continuing until 18 months ago, when he came under Dr. Young's observation. At this time the knee was partially ankylosed, there was thickening and induration about the patella, with atrophy of the muscles, and pain was excruciating. An exploratory arthrotomy was undertaken to verify the diagnosis of villous arthritis. The incision was a subpatellar one dividing all the structures in the anterior portion of the joint. The condition was found to be a fatty degeneration of the subpatellar bursa and synovial fringes. The recovery was uneventful and the functional use of the joint is perfect.

DR. OSCAR H. ALLIS said he had had four or five somewhat similar cases, but in these he thought the grade of inflammation was greater than in that of Dr. Young's case, and that that might have possibly been the reason why his results had never been so good. He had gotten fairly good motion, but nothing so complete as in the case presented.

Instead of the incision below, as in Dr. Young's case, which calls for the division of the patella tendon, Dr. Allis prefers an incision above the patella, as he does not think there is quite the same risk with this incision. A good view of the whole joint is obtained by either of these incisions, which are elliptical, turning the patella up in one instance, and down in the other. Dr. T. G. Morton was the first to split the patella longitudinally and turn the lateral halves outward, but with this procedure he did not think one got as good a view of the joint.

TENDON TRANSPLANTATION FOR TALIPES VALGUS.

DR. YOUNG presented a girl, 12 years of age, who had paralysis of the tibialis anticus muscle with marked valgus, of seven years' duration. For three months prior to the operation the deformity had been increasing. The operation performed five months ago consisted in the transplantation of the peroneus longus into the tibialis anticus, the valgus having first been restored to normal position. The foot is now in a corrected position and its function normal.

PSOAS ABSCESS CURED BY POSTERIOR OPERATION.

DR. YOUNG presented a girl, $4\frac{1}{2}$ years old, who was taken ill six months ago with incipient Pott's disease of the lower dorsal vertebræ. There was marked flexion of the thigh and psoas abscess was present. Four months ago the abscess was opened by a posterior incision, the so-called Treves operation. The abscess-cavity was curetted, the extremities of the wound were shortened by sutures, and drainage was maintained for only a very short time, the wound closing in seven weeks. The patient has now entirely recovered from the abscess.

LUDWIG'S ANGINA.

DR. JOHN W. PRICE read a paper reporting five cases of Ludwig's angina. For this paper see page 649.

DR. T. TURNER THOMAS (by invitation) in discussing this paper said he believed that Ludwig's angina was more common than is generally supposed, but that these five cases occurring in one hospital within ten weeks made it appear more common than even he had believed. He thinks there is no doubt regarding the diagnosis in any of Dr. Price's cases. In many cases, however, he says there is much confusion in the diagnosis, many being reported as Ludwig's angina which were simply cases of submaxillary cellulitis, because the patient could not open the mouth, had difficulty in swallowing, in speaking, and in handling the saliva. In every one of Dr. Price's cases he thinks there are typical symptoms of the condition as described by Ludwig, which began in the submaxillary region, with possibly the exception of the second case, which began in the mouth and is of a different

and more dangerous type. It is worthy of note that this was the only case which died.

Dr. Thomas considers that the danger in this condition is in the invasion of the larynx, and is particularly present when the floor of the mouth becomes involved because the tissue in the floor of the mouth is loose and contiguous with the submucous tissue of the pharynx and larynx, so that when this tissue is once involved it takes but a short time before the larynx is infected. Therefore, any infection of this character beginning in this region is a very dangerous condition, and the more dangerous, usually, the nearer its origin is to the larynx. Take, for instance, the cases reported by Semon; these were of the kind which begin in the region of the tonsil or in the neighborhood of the larynx itself, and in these cases the mortality was very high. A large number of them developed trouble also in the lungs or pleura.

Dr. Thomas considers that the most important point in the treatment of cases of Ludwig's angina is to recognize the focus from which the process is spreading and attack that. He does not believe the tonsillitis, the carious teeth, or the little ulcer in the mouth is the essential focus in the majority of cases. In one case reported in the literature the mouth became dangerously infected from a wound inflicted by the kick of a horse, knocking out several teeth; and lacerating the floor of the mouth. In one of his own cases the trouble began in the floor of the mouth from a gunshot-fracture of the jaw. He believes the great majority of cases begin in the submaxillary region, and that this is due to the fact that the infection enters the system by the way of a slight focus somewhere in the mouth, and from there extends to the lymphatic glands in the submaxillary region, where the infection becomes more active and causes rapid and great trouble; that is the real focus of origin.

Dr. Thomas does not believe much in the importance of the deep fascia of the submaxillary region as a restraining structure. He has dissected rather a large number of necks, and after taking away the platysma myoides muscle he believes what fascia is left is very delicate and cannot be an important structure in holding the swelling down.

DR. G. G. DAVIS said that the bacteriological examinations in Dr. Price's cases, as in practically all of the other cases reported,

showed the character of the infection to be of varying type. His paper also shows that the point of infection is not the same in every case. It is interesting that in two or three of the cases the teeth proved to be the infecting point, and the question suggests itself, was it the injection of the cocaine by the dentist, or was it the pulling of the teeth which caused the inflammation to start up? In a case which Dr. Davis reported a lawsuit was threatened to prosecute the dentist for introducing the infection, whereas it is very well known that dentists, as a rule, object very seriously to pulling teeth or doing any operative procedures on the mouth when there is a marked inflammation of the structures.

Mention was made by Dr. Price of the lymphatics, and Dr. Thomas likewise referred to the lymphatics carrying the infection from the centre or interior of the mouth to the outside of the jaw in the submaxillary region. Dr. Davis has never thought that the infection was transmitted primarily by the lymphatics. However, in one of his cases Dr. Price mentioned that some of the lymphatics were involved. This is the first case in which Dr. Davis has ever heard of involvement of the lymphatics, as such, being recognized. In other words, although we have lymphatics in profusion along the deep vessels of the neck, yet we do not find isolated enlargement of lymphatic nodes, but we do find inflammation spreading along the cellular tissue.

Dr. Davis thought particular attention should be called to the treatment in the cases reported. He thinks their prompt recovery was due to the vigorous treatment which they received. The appearance of a patient with this condition is really alarming, and when these cases fall into the hands of general practitioners who are not proficient in severe surgical procedures, they are afraid to make such incisions as are demanded in such cases. The extent of the incisions demanded was well shown in some of Dr. Price's cases, in which he made an incision into the mouth from the outside in the median line, and likewise incisions on both sides in the submaxillary region.

THE CONSERVATIVE TREATMENT OF FRACTURES OF THE FEMUR.

DR. A. P. C. ASHHURST read a paper entitled End-Results of Fractures of the Femur Treated Conservatively, for which see page 748.

DR. RICHARD H. HARTE said he could not understand why so many surgeons, instead of sticking to old and tried methods of procedure always wanted to try something else just because it was new. He really thinks it remarkable that in fractures of the thigh the results are so good, for he thinks this bone, above all others, is badly treated. Everyone seems to think that in order to treat a fracture of the thigh all that is necessary is to hang on to the heel 6 or 8 pounds of weights, paying no attention to the extension of the leg or the relative position of the sand-bags to the leg.

He thinks Dr. John Ashurst is the surgeon to whom the greatest thanks are due for the conservative treatment of fractures of the thigh. To obviate the use of sand-bags he reverted to the use of the old-fashioned Dupuytren's splint in conjunction with bran-bags and weights.

Dr. Harte does not recall a single case of ununited fracture of the thigh in his experience. In cases where there are multiple fractures, great allowance should be made, as Nature is only capable of repairing a certain number of fractures at a time. Very often the larger bone is the one which will be the slowest to unite.

DR. G. G. DAVIS said he thought the results in these cases rather surprising. When it comes to fractures below the neck we rather expect unfavorable results, but here in 21 cases of the neck we find 5 cases with apparently perfect functional results; 8 with no disability but a limp; 6 with marked impairment of function; and only 2 incapacitated. It is not infrequent for patients with intracapsular fractures to take to their beds and remain there until they die. Dr. Davis thought if the impairment of function in the 6 cases mentioned even allowed the patients to get around at all, that the results were surprisingly good, particularly when it is remembered that in these cases there were various forms of treatment. He understood that some of the methods pursued were not the so-called modern methods of abduction or lateral traction, but were simply the employment of the ordinary Buck's extension.

DR. A. P. C. ASHURST, in closing, said that of the 5 patients with fracture of the neck of the femur who recovered without functional impairment, two were children; one was a man 70 years of age. When this latter patient came back to the hospital

with no impairment whatever, it was necessary to look up his history, which showed that the diagnosis had been confirmed by a skiagraph, to convince the examiners that he had really sustained a fracture of the neck of the femur. Dr. Ashhurst added that Dr. Newell and he agreed entirely with Dr. Harte that the question of shortening was of secondary importance, since, as Dr. Harte said, it was of course impossible to know what had been the length of the fractured limb before the accident. He thought, however, if a patient had been so unfortunate as to have one leg an inch or more longer than its fellow, he would have to be congratulated should the result of his fracture enable him to be discharged with two legs of equal length.

GERSUNY'S OPERATION FOR THE CURE OF ENURESIS.

DR. GWILYM G. DAVIS presented a young girl, aged 15 years, who was admitted to hospital under his care with the following history: She had had most all of the diseases of childhood besides typhoid fever. Menstruation began at the age of 12, and she stated that she did not menstruate from the vagina but at each monthly period had considerable bleeding from the nose accompanied by headache. A year and a half previously she passed through an attack of typhoid fever at another hospital. She has always been of a nervous disposition and a year ago began to have nocturnal incontinence of urine. She passed urine involuntarily five to seven times each night. She was under treatment for the trouble in the medical ward and was afterwards operated on for appendicitis three months previous to her present operation.

Urine: Sp. gr., 1020, acid, no albumin nor sugar; few epithelial cells; no urethral polypus or other abnormal conditions.

She was etherized and the urethra surrounded by a circular incision and loosened from its surroundings. It was then twisted three-fourths of a turn on its longitudinal axis until a feeling of resistance was experienced, the margin was then sewn to the adjacent tissues by interrupted sutures of fine chromic gut. A catheter was inserted and retained for two or three days. Primary union occurred and she was soon discharged from the hospital cured.

The procedure used in this case was that devised by Gersuny (*Centralblatt für Chirurgie*, 1888) and is similar to his well-known operation for incontinence of feces (*Centralblatt für*

Chirurgie, 1893, 261). While his operation on the rectum is widely and favorably known, his operation on the urethra is comparatively little known and rarely employed. Incontinence of urine is so much more common than incontinence of feces that the field for the operation in the former class is much the wider. It is an operation comparatively easy of performance, lacking in any serious danger or after-effects and apparently efficient. It only needs to be more widely known in order to be more extensively employed.

A METHOD OF ANASTOMOSING THE DIVIDED VAS DEFERENS.

DR. GWILYM G. DAVIS said that a couple of years ago while aiding an inexperienced assistant to do an operation for the radical cure of an inguinal hernia the vas deferens was torn. It was strongly adherent to the hernial sac and in attempting to detach it he tore it in two.

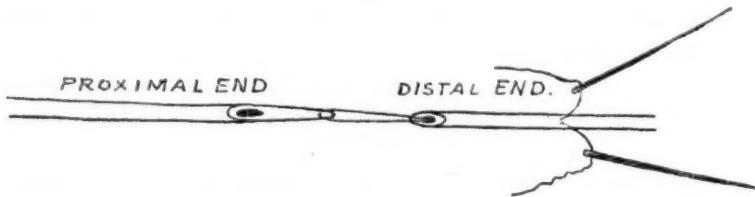
At the time the only methods known to Dr. Davis of repairing the injury were those which had been used for anastomosis of the ureter. The only method, as far as he knows, which has been devised for the anastomosis of the vas deferens is that of G. Frank Lydston (*Annals of Surgery*, July, 1906, p. 92, vol. xliv.) who cut the ends off square, then introduced a filament of silkworm gut on a filiform bougie through an opening in the side and sewed the two square cut ends together. The sheath of the cord was then sewn around the point of union and the bougie withdrawn in ten days.

The method adopted in the present case was a modification of that devised by Poggi for the ureter. Poggi (*Archives Provinciales de Chirurgie*, vol. vi, June 1, 1896, quoted by Morris *Surg. of Kidney and Ureter*) dilated the distal end of the ureter and drew the proximal end into it by two sutures, one on each side. Both ends of the ureter were cut off square.

Mayo Robson modified this by slitting the distal end to facilitate the entrance of the proximal end. Van Hook introduced the proximal end through a slit in the distal end on which a ligature had been placed to close its extremity. In the case now reported the proximal end of the divided vas was cut off obliquely so as to leave a moderately long pointed extremity; the distal end was cut off on a short bevel, about 45°.

A piece of fine catgut was then threaded on two fine round sewing needles. One of these needles was passed through the tip of the proximal end then introduced into the lumen of the distal end and made to pierce the wall well beyond the opening. The second needle was then likewise introduced and brought out close to the first (Fig. 1).

FIG. 1.



Traction was made on the threads and the pointed extremity of the proximal end entered the lumen of the distal end without the slightest trouble until its apex reached the point of emergence of the needles. The catgut was then tied and the apex fixed in place. Two additional fine catgut sutures were introduced, fixing the extremity of the distal end to the side of the proximal end as seen in the lower figure (Fig. 2). Healing occurred by primary

FIG. 2.



union, no epididymitis nor testicular complication occurred, and as far as known the result was satisfactory.

In making the anastomosis care should be taken not to make the pointed bevel on the proximal end too long and also to introduce the needles nearly or quite their full length before piercing the side of the tube. The object of these two precautions is to separate as far as possible the two openings in the proximal and distal ends.

It appears to be unnecessary to slit the ends as did Mayo Robson and Van Hook in the ureter, and the procedure seems both easier of performance and more sure than that of Lydston.

DR. JOHN H. GIBBON, relative to the anastomosing of the divided vas deferens, asked if Dr. Davis knew anything of the end-result in his case; whether there was testicular atrophy.

Dr. Gibbon once, very much to his distress, divided the vas in a young man, and did an invagination anastomosis, very much after the style of Murphy's anastomosis of a blood vessel. Although he was very much disappointed at the time of this accident, he got a great deal of comfort in finding out that a number of men who had done a large number of hernia operations had had a similar experience. He feels certain, however, that such an accident having once occurred, it is never likely to be done by the same operator again. In reply to this question Dr. Davis stated that the later history of the patient was not known to him.

THE USE OF CHLORIDE OF ETHYL AS A GENERAL ANÆSTHETIC.

DR. W. E. LEE read a paper with the above title, giving a report of 5000 cases at the Pennsylvania Hospital. For this paper see page 641.

DR. G. G. DAVIS asked how many of the patients which died were colored people? He thinks anæsthetics are far more fatal with this race than with white people because their color prevents the early recognition of the changes due to failure in the circulation.

DR. JOHN H. GIBBON said Dr. Lee had shown how superlatively statistics can lie, and he thinks that everyone reaches his own conclusions as to the safety of anæsthetics from his personal experience. For five or six years Dr. Gibbon has used chloride of ethyl absolutely for short operations, nothing but chloride of ethyl, and practically always uses it as a preliminary to ether. He has in his experience but one death to report. That was in a man who had a Ludwig's angina and an endocarditis. He was afraid to give him any general anæsthetic because of his heart condition, and therefore infiltrated the line of incision with Schleich fluid first, and then he found that the patient had a lot of exudate deep down in his neck and manipulation was very painful, so it was necessary to give him an anæsthetic. Chloride of ethyl was given, followed by ether, and Dr. Gibbon then evacuated a quantity of turbid fluid from behind the sternum. Just as this fluid was evacuated the patient ceased breathing and died on the table. No ether had been given for a number of minutes, as the patient seemed completely anæsthetized. A quick

tracheotomy was done and artificial respiration kept up for some time, but without avail.

As Dr. Lee has said, deaths in these cases occur from any anæsthetic. Excepting the case just recorded Dr. Gibbon has never had a death from chloride of ethyl, and he has used it thousands of times with the greatest impunity. His feeling is that in safety it occupies a place between ether and chloroform. Most people think it more fatal than ether, and probably less than chloroform. Dr. Gibbon gives it to the youngest and to the oldest patients—children a few days old, very ill patients with typhoid perforation, and patients with tuberculous lesions of the lungs. It is the anæsthetic of choice in his worst cases.

In one, a tuberculous case, he resected four ribs for empyema, and he has done other extensive operations lasting as long as twenty minutes. In the cases where death has occurred, he thinks it would have occurred with any anæsthetic. He has had more than one death occur on the table from ether alone, and in one of these cases there was no pulmonary or cardiac lesion. The patient was suffering from tuberculous glands of the neck and died just as the incision was made.

Dr. Gibbon's experience with chloride of ethyl makes him feel that it is a safer anæsthetic than ether. It is not disagreeable to take, and he says this because he has himself taken it. He does think it should be given with discretion. It has the great advantage of shortening the time for the anæsthetic and cutting down the amount of ether which the patient will have to inhale and afterwards eliminate.

In comparing the mortality in anæsthesias we should also include the cases of postoperative pneumonia, bronchitis and suppression of urine occurring as a result of ether.

DR. A. P. C. ASHHURST reminded the Fellows that his father, the late Dr. John Ashhurst, Jr., used to lay a great deal of stress on giving ether in a good light, and constantly inveighed against the miserable dark holes provided for the administration of anæsthetics in one large hospital to which he was surgeon.

DR. RICHARD H. HARTE had used ethyl chloride a great deal and for many years, but is not as enthusiastic over its use as some operators are. Every time he gives it it is with a feeling of uncertainty, because one cannot carelessly give an anæsthetic which is so quick in its action. He has many times started to count twenty

with the beginning of this anæsthetic and by the time twenty would be reached the patient would be completely anæsthetized. The great danger of this anæsthetic is therefore the little warning which is given. It is, however, one of the most delightful anæsthetics which can be imagined—no nausea, no choking sensation, no distress of any kind, the patient simply passing into a quiet sleep.

Dr. Harte feels, however, that if it was used as indiscriminately and as carelessly as is ether, the mortality from its use would be much greater. He considers it a great wonder, with the careless way in which ether is administered, that its mortality is not greater. Ethyl chloride is given by few surgeons, and only practically by persons skilled in its use or in the use of anæsthetics, and consequently the mortality rate is low. It has a great many advantages, particularly preliminary to the administration of ether, and it has also undoubtedly cut down the quantity of ether necessary to complete unconsciousness.

Dr. Harte never gives ethyl chloride except as a preliminary in any case where he expects a delay. He uses it for opening an abscess or for putting in a drainage-tube, but where the patient is to be kept under the anæsthetic for any length of time, say more than five or six minutes, he does not use ethyl chloride.

Relative to the remark made by Dr. Gibbon that he had never experimented with anæsthetics on himself, Dr. Harte thought more could be learned from such experimentation than from the anæsthetization of five hundred other people.

DR. W. JOSEPH HEARN agreed with Dr. Harte that the rapidity with which anæsthesia is induced with chloride of ethyl is its chief danger. A few years ago at the Jefferson Hospital when the bottle of ether was immersed in a tub of hot water during administration it was found that the concentration of the vapor was too great, and this method of administration consequently had to be abandoned because the anæsthesia was induced so rapidly that it was hard to recognize the danger signals.

DR. WALTER E. LEE, in closing, said that in regard to the color of the patients who died, all five of them were negroes and that one of the ether deaths occurred in a patient of this same race. The question of the rapidity of the appearance of anæsthesia, of which Dr. Harte and Dr. Hearn have spoken, is undoubtedly an objection to the general use of ethyl chloride. As

it is given in England in large mass doses of from 3 to 10 c.c. in a closed inhaler with the admission of very little air, deep anaesthesia is reached after 5 or 10 inspirations. In Dr. Lee's experience the danger signs during the administration of ethyl chloride are very difficult to recognize, the slowing of the respiration is insidious and they have probably ceased for some seconds before the anaesthetist realizes it. For this reason the closed inhalers have been abandoned in the hospital and the open method used which has lengthened the administration period from 8 to 10 seconds to 3 to 4 minutes, giving more time for the recognition of the danger signals.

BOOK REVIEWS.

THE PANCREAS: ITS SURGERY AND PATHOLOGY. By A. W. MAYO ROBSON, D.Sc. (Leeds), F.R.C.S. (Eng.), of London, and P. C. CAMMIDGE, M.D. (Eng.) D.P.H. (Cambr.), of London. Octavo vol., pp. 546. Illustrated. W. B. Saunders Co. Philadelphia and London. 1907.

THE present monograph by the authors succeeds in some degree that published by Robson and Moynihan a few years previous. The association of an expert chemist with a surgeon who has had such an extensive experience in the diseases of this organ, has certainly given to the literature a contribution which at the present time ranks preëminently.

The scope of the work, however, is considerably more comprehensive than its title would indicate. Thus in the first seven chapters we find an exhaustive and excellently compiled treatise on the comparative anatomy, anatomy, embryology, anatomical anomalies, surgical anatomy, histology and physiology of the pancreas. The authors here, as in the remainder of the monograph, have used all of the more important contemporary literature in conjunction with their own researches, a short bibliography being appended at the end of each chapter indicating the references used in the subject under discussion. Then follow two chapters on pathology and fat necrosis, leading directly up to that on chemical pathology; here is described the "Cammidge Reaction"; the methods employed certainly seem in some degree rather empirical, and were it not for the results obtained would be rather disquieting; the analysis is exacting and must be followed carefully or results will not be obtained; especial attention should be directed to the last step of using a hot filter paper and funnel.

The question of diabetes is of great interest. The author's conclusions are in effect that a small portion of normal gland is capable of averting the onset of the condition, and therefore the importance of recognizing diseases of the pancreas early is emphasized. Advocacy of early operation in gall stones, especially in the common duct when urinary analysis shows pancreatic

involvement to be present, is deservedly mentioned. The consideration of the faeces as indicative of digestive disturbance, as well as that of the urine for changes in the internal metabolism, is of great diagnostic value.

An interesting observation is that the presence of biliary secretion is not sufficient to insure a return of the normal color to the faeces when pancreatic secretion is not established.

The surgical progress in the treatment of pancreatic conditions is shown with the report of several cases. The authors illustrate uselessly some X-ray photographs showing the difference between gall stones and pancreatic calculi. These, however, have been taken outside of the body and the conclusions drawn from them are entirely at variance with those found when the exposure is made *intra vitam*.

The book is completed by the chapters on injuries; inflammatory affections; acute, sub-acute and chronic pancreatitis; pancreo-lithic catarrh; calculi; cysts; and neoplasms. That on the general symptomatology and diagnosis is of particular fulness and interest, and is sure, when taken into consideration with the various chemical and microscopical adjuncts placed at our disposal, to alter the views of many physicians and surgeons at present that only the grosser lesions of pancreatic affections may be recognized.

JAMES T. PILCHER.

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